Statement of the Coal Utilization Research Council (CURC)

Submitted to the Subcommittee on Energy

Committee on Science, Space and Technology

Hearing on

"The Future of Coal: Utilizing America's Abundant Energy Resources"

Thursday, July 25, 2013

A.1. Introduction and Summary of the CURC written statement

This statement, submitted on behalf of the Coal Utilization Research Council (CURC), addresses the findings and recommendations of the CURC-EPRI Roadmap, as well as research activities and policy considerations that will be critical to ensuring continued affordability and reliability of coal in the near, mid, and long-term.

To respond to the questions posed by the Committee this statement addresses the following:

1. **Coal is a vital domestic resource that provides low-cost and reliable electricity** - Our vast, domestically secure supply of coal has fueled the American economic machine for hundreds of years and our fleet of existing coal-fired power plants provides very inexpensive electricity. This means that U.S. industry has a competitive edge over manufacturers in other countries that do not have reliable, abundant, low-cost electricity generated from coal resources, and consumers are able to keep more of their income to spend on other expenses.

   Furthermore, as of 2012, coal continued to provide 37% of the electricity generated and consumed in this country. The Energy Information Administration (EIA) projects in its latest Annual Energy Outlook, (2013) that coal will continue to provide approximately 40% of our electricity needs through 2040 (the end of the EIA projection period). Given that the nation will continue to rely on coal, it is imperative that technologies be developed that allow for coal to be used in an increasing clean and economic manner.

   Finally, it is important to remember that diminishing or extinguishing the use of in the United States, a totally unrealistic scenario, will not address global emissions of CO_2 given the enormous growth of coal worldwide. Technology to control or prevent such emissions is the answer.

2. **But the Coal Industry Faces Several Challenges -** Coal's challenges are associated primarily with the cost of complying with an array of recent and pending Environmental Protection Agency (EPA) environmental requirements as well as competition from low cost natural gas. While existing coal-fired power plants are highly competitive with other sources of electricity, the added cost of recently adopted environmental regulations (new-source

PSD/BACT permitting), uncertainty over future regulations (recently promulgated CO_2 emissions standards for new and existing plants under Section 111 of the Clean Air Act), and other factors have led to projections that approximately 60-80 GW of older coal-fired units (20-25% of the current 310 GW coal fleet) will retire over the next several years. Furthermore, EIA projects that once 6 gigawatts of coal units now under construction commence operation (by 2015), there will be essentially no additional coal units built until after 2035, and only 1.5 gigawatts by 2040.

3. **Technology has solved coal's economic and environmental challenges in the past, and technology development and application can again solve these concerns --** CURC's members believe that the development and application of technology to the current and future fleet of coal-fired power plants will enable our nation's coal resources to continue to contribute to the nation's generation mix while simultaneously addressing environmental and economic concerns. The proven formula for success in addressing environmental and economic concerns has been the collaborative, cost-sharing efforts of the government through the Department of Energy's Coal R&D Program and the private sector. Today, three out of every four coal plants in the U.S. are equipped with technologies that trace their origins to DOE's coal R&D program. The successful development and use of technologies have allowed coal use to increase by more than 180% since the early 1970s while the emissions rates of SO_2 and NOx have decreased by approximately 85%. In addition to developing commercial technologies to control criteria pollutants for NOx, SO2, particulate matter and mercury, the government and industry partnership is responsible for the commercial deployment of pressurized fluidized bed combustion systems, new coal-based IGCC systems, advanced turbines, and development of materials for highly efficient advanced coal combustion power plants.

   The key to ensure continued success is (1) adequate public support, (2) enhanced levels of funding targeted to specific technology areas, and (3) a regulatory and public policy framework that supports coal use.

4. **The CURC-EPRI Technology Roadmap Defines Technology Development Needs and Timelines -** CURC, together with the Electric Power Research Institute (EPRI), has developed a Technology Roadmap (Roadmap) that defines the research, development and demonstration necessary to ensure that the benefits of coal utilization in the U.S. continue into the future. The Roadmap represents a plan for developing technologies that convert coal to electricity and other useful forms of energy as well as into manufacturing feedstocks. Our Roadmap and accompanying analysis concluded that several coal technology advancements, if developed, will achieve specific cost, performance and

environmental goals thereby benefiting the nation's environment, economy, and energy security.

Importantly, the Roadmap strongly recommends that the Department of Energy continue supporting the current suite of select CCS demonstration projects and, in the future, make authorizations to encourage additional demonstrations and deployment of "second generation" and transformational coal technologies.

5. **Funding requests by the Administration must be significantly increased -** The Administration's FY 2014 recommended funding level of $276.6 million and the House's recommendation of $315.9 for Coal Research & Development at the Department of Energy is not sufficient to accomplish the important R&D necessary to support our nation's most abundant and valuable domestic resource. The reduction in federal funds will reduce private and public investments, slow development timelines, and could cause the abandonment of promising new technologies at a time when we should be aggressively supporting the development of technologies designed to overcome environmental concerns of coal use. The CURC-EPRI Roadmap recommends $372 million per year in funding for DOE's coal R&D program for fiscal years 2014 through FY 2018.

6. **A Strategic Path Forward: The CURC 3-Part Technology Plan -** CURC members have developed a technology program that aims to insure the use of coal in a cost-competitive, environmentally superior and reliable way today and well into the future (2050 and beyond). The three-part CURC technology program is designed to encourage the use of coal in the:
   - **Near-term** by applying technology solutions to the existing fleet of coal-fired electric generating plants to better insure efficiency, output, reliability and emissions-control.
   - **Mid-term** by authorizing the construction of 10 GWs of advanced coal plants that are highly efficient and superior in ability to control emissions and that will install carbon capture systems when that technology is commercially available. A second program that provides financial incentives for the capture of CO_2 to recover crude oil while directing tax receipts and royalties (not new taxes) from that recovered crude oil to pay for the CO_2 capture systems.
   - **Long-term** by focusing federal appropriations toward a RD&D program that has the goal of cost competitive, environmentally superior, and transformational uses of coal for the future.

B.1. Who is the Coal Utilization Research Council (CURC)?

The Coal Utilization Research Council (CURC) is a coalition of coal-using utilities, coal producers, equipment suppliers and manufacturers, universities and institutions of higher learning, state

government entities, labor organizations as well as industry trade associations.[1] Our membership is joined together to promote the research, development, demonstration and deployment of technologies that will enable the long term use of our nation's abundant coal supplies in a cost-effective and environmentally acceptable manner. A listing of our members can be found by visiting our website at www.coal.org.

B.2 Why Coal and Coal Technology Are Important

Before addressing the technology-related questions posed by the Energy Subcommittee in the invitation to testify, it is important to underscore why coal remains so important to the Nation.

a. Coal is widely available, affordable and reliable

Continued and expanded utilization of America's vast coal resources is in the public's interest. Coal-based energy has long been the foundation of social and economic development in our country allowing more people to live better and live longer. Coal conversion to electricity, liquid fuels, or chemicals enables the United States to meet the ever-rising demand for energy. Clean coal technologies including higher efficiency generation and carbon capture, utilization and storage (CCUS) are pathways toward achieving sustainable energy, economic growth, and climate change policy goals. Further, affordable and reliable electricity driven by coal enables the expansion of electro-technologies, which are the basis of modern society.

Our vast, domestically secure supply of coal has fueled the American economic machine just as it is now fueling the phenomenal industrialization of China– as well as the economies of India, Vietnam, and other emerging economies. Lest we forget, given the almost daily news suggesting the demise of coal, this energy source provided 37% of the electricity generated and consumed in this country in 2012. And, the Energy Information Administration (EIA) projects in its latest Annual Energy Outlook, (2013) that coal will continue to provide approximately forty percent of our electricity needs through 2040 (the end of the EIA projection period). The reliance upon coal stretches well into our future as it remains an essential supplier of energy in the United States for decades to come.

Also, as we consider questions about climate change and U.S. regulatory programs CURC believes it is worth noting that if the United States simply were to abandon coal, a scenario that is unrealistic, the impact to global CO_2 emissions would be relatively small. To combat global CO_2 emissions, the U.S. must play a lead role in the development of technologies that can (and will) be deployed in China and India and elsewhere, to reduce global carbon emissions. Without technology innovation in this country, and initiatives sponsored and supported by the Department of Energy (DOE), a significant reduction in global GHG emissions is unlikely (see: Attachment A comparing China's growing use of coal to the U.S. and the rest of the world).

b. Coal-based power generation is important to the American economy

[1] Several members of CURC, including not-for-profit organizations as well as institutions of higher education, are prohibited from advocating public policy positions and therefore, to the extent this statement includes policy-related recommendations, such member organizations are not to be considered as associated with such recommendations.

Our coal-based power generation is fully dispatchable – when you need it, it is there. Other sources of electric power have their attributes, but may not be available when you need the electricity if the sun is not shining, if the wind is not blowing or if the costs of a fuel become volatile and not affordable compared to consistently stable, low-priced coal resources.

Our fleet of existing coal-fired power plants also provides relatively inexpensive electricity, and low cost power means that consumers keep more of their income to spend on other expenses. This also provides U.S. industry with a competitive edge over manufacturers in other countries that lack access to reliable, abundant, low-cost electricity generated from coal resources (see: Attachment B which depicts state-by-state cost of electricity and percent of electricity provided by coal). And, the availability of low-cost electricity is a key component to President Obama's recently announced initiative to grow manufacturing in the U.S. As a general rule of thumb, a 10% reduction in the cost of electricity leads to a 1% increase in gross domestic product and employment.[2] That equates to 1.5 million jobs. In short, our economy is greatly impacted by the price of electricity, which can be influenced by the timing and stringency of regulations to address emissions from coal.

c. Technology to capture CO_2 from coal can significantly aid energy security

While regulations are being considered to limit carbon dioxide (CO_2) emissions from power plants, it is important to keep in mind that we are developing effective technologies to capture CO_2 emissions from coal fueled facilities which can be used for the enhanced recovery of crude oil that remains trapped in reservoirs after primary and secondary production has been completed. Between 20 to 60 billion barrels of oil remain in numerous reservoirs in the U. S., not including the Bakken shale reservoirs where some estimate that only 3 to 5% of oil is currently recovered and billions of barrels of oil remain. [3] Carbon dioxide is the primary means by which this oil can be recovered. There are other sources of less costly anthropogenic (captured) CO_2 currently available, but if industry determines it is beneficial to recover the bulk of these remaining domestic oil resources, then coal-derived CO_2 is required because there are not sufficient alternative sources of CO_2 available to recover the quantities of crude oil available.[4] (See: Attachment C for additional information on estimated economic and technically recoverable crude oil potentially recoverable through the use of CO_2). A resolution to questions regarding storage where CO_2 is utilized for enhanced oil recovery must occur if the country is to reap the benefits of using captured carbon dioxide to recover crude oil. Further, while not all coal-fired power plants are near these oil reserves, many are located in close proximity to suitable oil fields. For example, in the Gulf Coast of the U.S., there is already a need for anthropogenic CO_2 to expand Enhanced Oil Recovery (EOR).

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[2] Climate Policy and Labor Markets, O. Deschenes, Working Paper 16111, National Bureau of Economic Research, June 2010, http://www.nber.org/papers/w16111 .

[3] See: http://www.eenews.net/energywire/2013/06/06/stories/1059982389 , quote by W.F. "Rick" Bott, president and chief operating officer of Continental Resources Inc., a current oil producer in the Bakken

[4] PowerPoint presentation by Phil DiPietro, NETL, Office of Strategic Energy Analysis and Planning, March 9, 2012

Several Department of Energy (DOE) demonstration projects are being developed right now that will integrate CO_2 capture technology with electricity generation and then offset part of the overall costs by selling the captured CO_2 to companies engaged in EOR.

d. Technology ensures continued use of coal which is essential for fuel diversity

Successful development of advanced coal technologies can best ensure that coal remains an option for the generation of electricity. And maintaining this diversity in fuel choice is a hedge against volatile fuel prices (e.g. natural gas prices) or potential scarcity of long-term supply of competing fuels, thereby better ensuring electricity generators can continue to provide reliable, uninterruptable and affordable electricity for American consumers. Residential, commercial and manufacturing consumers of power will reap the benefits of maintaining fuel options and for coal – technology is the pathway towards providing that insurance.

B.3. Coal's Current Challenges

All sources of energy face challenges in today's marketplace. Depending on the fuel form, the challenge may be cost of extraction or use, intermittency, infrastructure needs, or environmental impacts. In the final analysis, challenges usually boil down to increased costs. Coal's challenges are associated primarily with the cost of complying with an array of recent and pending Environmental Protection Agency (EPA) environmental requirements and market competition with currently plentiful, low cost natural gas. Additionally, the global economic slowdown has resulted in historically flat demand for additional electric generating capacity. The bulk of research associated with coal seeks to reduce sharply the cost for coal to meet future emission limitations through continued progress in coal technology development.

a. Significant coal plant retirements with modest coal builds through 2040

Existing coal-fired power plants are highly competitive with other sources of electricity, as demonstrated by the fact that coal continues to provide more electricity in the U.S. than any other fuel. However, the added cost of new and pending environmental regulations, uncertainty over future regulations, and other factors have led to projections that perhaps 60-80 GW of older coal-fired units (20-25% of the current 310 GW coal fleet) will retire over the next few years. A partial listing of recently proposed or promulgated environmental regulations affecting coal include rules limiting interstate transport of SO2 and NOx, the Mercury and Air Toxics Standards, revised New Source Performance Standards (SO2, NOx, and PM limits), the Coal Combustion Residuals rule (ash management), revised Effluent Guidelines and New Source Performance Standards for releases to water bodies, and revised Cooling Water Intake Structure rules. Climate change- related rules are discussed below.

With respect to the U.S. market for new power plants, the DOE/EIA's most recent Annual Energy Outlook projects that the overall electric power sector (including all fuels) will shrink from 1006 gigawatts of capacity in 2013 to 986 gigawatts in 2020. EIA projects that once 6 gigawatts of coal units now under construction commence operation (by 2015), there will be essentially no additional coal units built until after 2035, and only 1.5 gigawatts by 2040. These projections assume current regulations and do not reflect any future regulations limiting CO_2 emissions.

b. The regulation of carbon dioxide emissions and challenges for coal use

Most government-sponsored coal RD&D focuses on reducing the cost of systems to control CO_2 emissions.[5] Carbon is the major constituent of coal and it is the oxidation of carbon to CO_2 which produces most of the thermal energy produced when coal is burned. It is important to understand that, although additional regulations are under development, the EPA already regulates CO_2 emissions from new coal-based power plants through the Prevention of Significant Deterioration (PSD) permitting process. Each proposed new coal-based power plant must install best available control technology (BACT) for limiting CO_2 emissions as determined on a case-by-case basis by the permitting authority through the PSD process. Any available CO_2 emissions control technology or measure must be considered in setting a specific BACT limitation for the plant, although the permitting authority can eliminate those CO_2 control options that are technically infeasible or prohibitively expensive.

In addition to the current PSD regulation of CO_2 emissions from new coal-fueled power plants, two additional rulemakings are under development by EPA to set CO_2 performance standards under Section 111 of the Clean Air Act (CAA). Both rules will be governed by the statutory requirement that these performance standards must reflect "*the best system of emission reduction which (taking into account the cost of achieving such reduction and any non-air quality health and environmental impact and energy requirements) the Administrator determines has been adequately demonstrated*."[6]

1. The first rule will set CO_2 performance standards under Section 111(b) that directly apply to new coal-fueled power plants.
2. The second rule will establish federal emissions guildelines under Section 111(d) that will require states to set CO_2 performance standards for existing coal-fueled power plants.

With respect to the first rulemaking, EPA initially proposed in April, 2012, a CO_2 New Source Performance Standard (NSPS) for new coal-based power plants. The proposed limit was 1000 pounds of CO_2 per gross megawatt-hour of power generation, about half the emission rate for a coal-fueled unit without any add-on CO_2 emissions control technology. The rule would essentially require the use of carbon capture and sequestration (CCS) technology on any new coal-based power plant in the U.S. CURC provided comments to EPA and noted that "there is no system of controls that has been adequately demonstrated to achieve this standard for new coal fueled power plants." CURC also stated the belief that EPA's approach to apply CCS technology after a plant had been operating for 10 years was impractical for several reasons, including the inability of a plant owner to make a large capital investment in a new plant without assurance that the CCS technology needed in 10 years would be commercially available and affordable.

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[5] The CURC does not take a position for or against potential regulations or legislation addressing greenhouse gas control but if public policy is adopted to establish a control regime then it is vitally important that cost-effective technology is available to control carbon dioxide emissions from coal use.

[6] Clean Air Act, Section 111(a).

The Office of Management and Budget (OMB) is now reviewing a re-proposal of the 2012 proposed rule, and the President has directed that this new proposed rule be issued by September 20, 2013, followed by a final rule after EPA considers public comments filed on the new proposal. The President has also directed EPA to propose the second rule, for existing coal-based power plants, by June 1, 2014, and finalize that rule one year later.

CURC members have made major financial commitments to the development and demonstration of CCS technology. With time and adequate resources, we believe that industry can demonstrate that CCS is commercially available and economically viable for utility-scale applications. Although EPA was overly optimistic regarding CCS technology in its 2012 proposed performance standards, the Agency was notably unwilling to make an affirmative determination that CCS is an "adequately demonstrated" CO_2 control technology for setting a performance standard, as required by the statute. It is essential that we not overreach the capabilities of technology in setting these standards.

In addition to the technology and cost challenges facing CO_2 capture technology, challenges exist for CO_2 storage approaches, as well. There are significant unresolved "legal framework" barriers to CO_2 storage in saline formations, including exposure to significant liabilities and risks for scores of decades after closure of the power plant. The good news is that, assuming these barriers are adequately addressed, the North American continent has promising storage sites for thousands of years of CO_2 emissions from electric power generation.[7] Again, not all power plants are located in close proximity to potential CO_2 use in EOR applications and because the source of CO_2 (i.e. power plant) is not in close proximity to any EOR field then storage in saline formations could be the only option. This means that these legal framework barriers must be addressed concurrent with the development of CO_2 capture technologies.

B.4. Track Record on Technology: Solving Challenges with Technology

Congress should be confident that challenges to the use of coal, most specifically those related to the control or capture of CO_2 from coal use, can be addressed through the successful development and use of technology. We are not there yet; significant time and financial support are required, along with a realistic understanding that simply directing or assuming the existence of technology will not make it so.

Since the early 1970s, the DOE Coal RD&D program and DOE's National Energy Technology Laboratory (NETL) have been responsible for developing innovative technologies for coal-fired power plants such as low nitrogen oxide (NOx) burners, Selective Catalytic Reduction (SCR), flue gas desulfurization (scrubbers), and fluidized bed combustion, all of which are now in the marketplace and benefitting energy production and air quality improvements.[8] In fact, today, three out of every four coal-burning power plants in the U.S. are equipped with technologies that can trace their roots back to DOE's advanced coal technology program.

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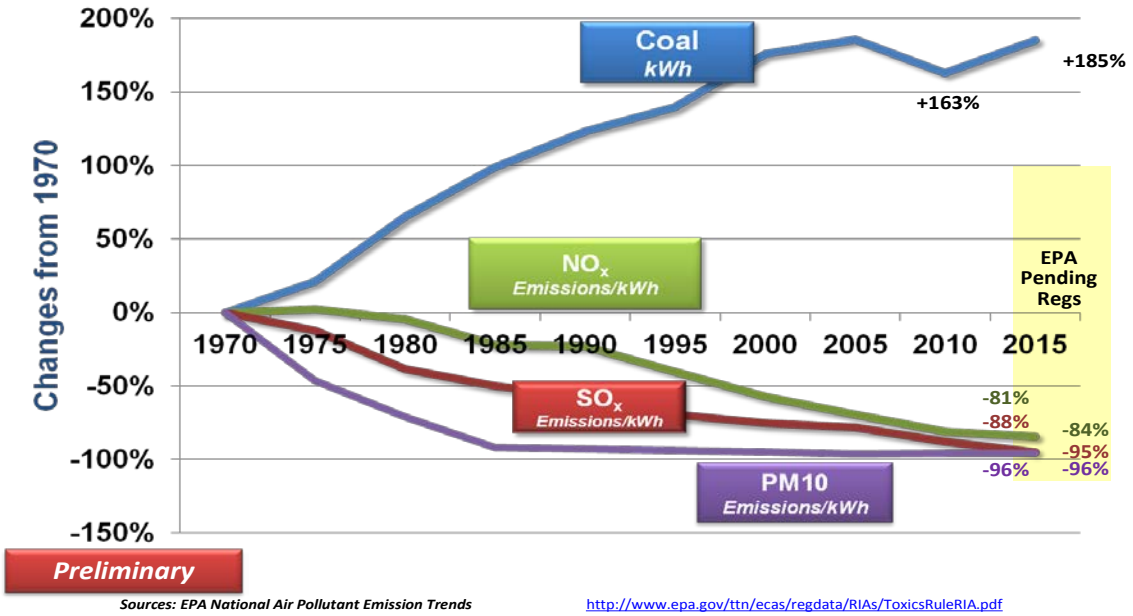
[7] The DOE/NETL atlas of geology favorable to CO_2 storage has identified deep underground saline geologies which could accommodate 2 – 20 trillion tonnes of CO_2. This range is enough to store the CO_2 from the entire U.S. coal-fueled fleet operating for 1,000 to 10,000 years.

[8] http://energy.gov/sites/prod/files/roi_factcard.pdf

The benefits from federal investment in these technologies is evidenced by the fact that coal use in this country has increased by more than 180% while the rate of emissions of criteria pollutants, such as SO_2 and NOx, has decreased by an average of 85% since enactment of the CAA in the early 1970s.

Coal-fired Generation Emission Rates



Sources: EPA National Air Pollutant Emission Trends http://www.epa.gov/ttn/ecas/regdata/RIAs/ToxicsRuleRIA.pdf
EIA Annual Energy Review, EIA AEO 2011, Ventyx – Velocity Suite

Furthermore, DOE estimates that the public and private sector RD&D collaborations through the Department's clean coal technology programs have provided great value to the taxpayer yielding a return of $13 for every dollar of federal funding spent for coal RD&D between 2000 and 2020.[9] Reducing the cost of mercury control by 50-70% helped save the industry $4 billion to $5 billion annually in implementation costs, and NETL in coordination with the private sector was responsible for the development and deployment of this technology.[10]

DOE, through NETL and its coal RD&D programs, together with cost-sharing from industry, have demonstrated that technology research, development, demonstration and deployment can be used to significantly reduce emissions from coal-fired power plants. And just as technology has been used in the past to address environmental challenges associated with coal use, we can develop technology again to address CO_2 emissions and further reduce traditional pollutant emissions, if given sufficient time and sustained government support for technology development.

[9] Ibid.
[10] Ibid.

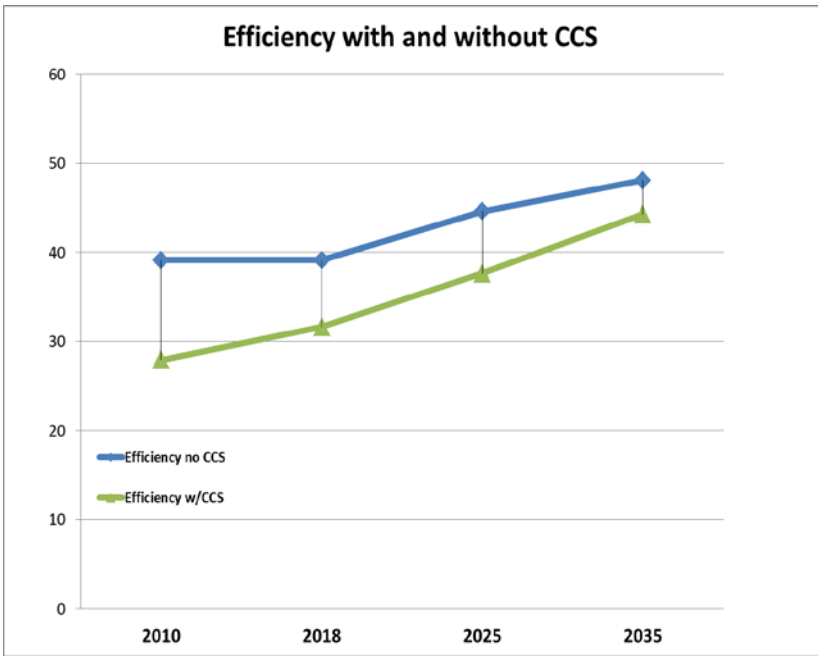
B.5. CURC/EPRI Roadmap

CURC, together with the Electric Power Research Institute (EPRI), have developed a Technology Roadmap (Roadmap) that defines the research, development and demonstration necessary to ensure that the benefits of coal utilization in the U.S. continue into the future. The Roadmap represents a plan for developing technologies that convert coal to electricity and other useful forms of energy as well as into manufacturing feedstocks. Our Roadmap and accompanying analysis concluded that several coal technology advancements, if developed, will achieve specific cost, performance and environmental goals thereby benefiting the nation's environment, economy, and energy security.

An earlier CURC/EPRI Technology Roadmap was published by CURC and EPRI in 2008. The CURC membership began updating the 2008 Roadmap in 2011 and finalized the updated Roadmap in the summer of 2012. This updated Roadmap includes new data on recent advances in technology; addresses the increased stress on the U.S. economy which has diminished our ability to support technology development; accounts for the increased supplies of natural gas; and recognized the uncertainty of policies with respect to controlling emissions of CO_2.

a. Technology Benefits

Improvements in power plant efficiency with successful R&D

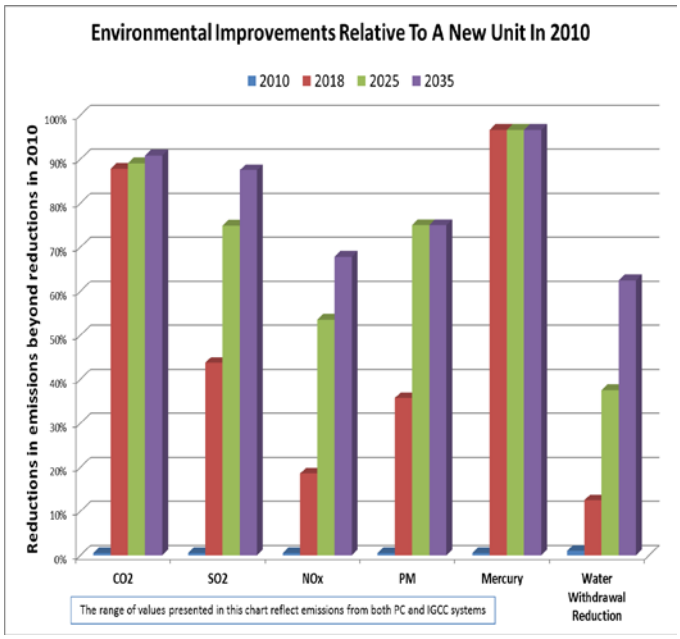


One of the most significant benefits from the proposed technology improvements identified in the Roadmap is the increase in efficiency of power generation. This improvement in efficiency reduces all emissions, including CO_2, due to less fuel being required for a given amount of electrical generation. Improvements in overall power plant efficiency for combustion-based systems as well as significant cost reductions in gasifiers and improved gas turbines are projected to result in a levelized cost of electricity (LCOE) for these advanced coal fueled systems with CCS that is lower than today's coal-fueled power plants without CCS .

Other additional benefits of successfully implementing the Roadmap include (1) aggressive reduction of water use/discharge, (2) significant reductions in traditional air pollutants and CO_2, (3) enhanced energy and economic security via production of low cost power using coal, our

largest U.S. domestic energy resource while using captured CO_2 to recover crude oil, and (4) deploying coal-based technologies for the production of liquid fuels and other marketable products.

Improvements in the control of conventional pollutants and water conservation



2010 "State of the Art" Baseline Data

Reductions reflect a range of values for both PC and IGCC technology changes after 2010, but the reductions in 2010 are very significant:

- **CO_2:** 0% (no carbon controls in use)
- **NOx and SO_2:** 90 - 99% reduction
- **PM:** 99.6% reduction
- **Mercury:** 90% reduction
- **Water Withdrawal Reduction** (as a result of cooling towers): 98%

b. The Importance of on-going demonstrations

First, the Roadmap requires that the current suite of "first-generation" CCUS demonstration projects are fully launched and successfully operated. These projects, which are currently underway or in the planning process, are receiving or have received funding from industry and the federal government through demonstration grants (the Clean Coal Power Initiative (CCPI) or the Industrial Carbon Capture and Storage (ICCS) program) or other financial incentives (§§48A & B tax credits). It is important to note that power generation equipped with CCUS technology is not yet affordable. In fact, a number of projects selected for demonstration by the DOE through the variety of cost-share or financial incentive programs have since been cancelled. Project sponsors have concluded, even with substantial government-offered support, that continuation was not economic.

c. The need for additional demonstrations – ultrasupercritical and CO_2 for EOR

Concurrent with the need for successful demonstrations of first generation projects, it is highly important that subsequent demonstrations be undertaken. Given the prospect that the market alone will not be sufficient to undertake additional demonstrations of the technologies currently undergoing planning and construction, CURC strongly recommends that authorizations be made to encourage additional demonstrations and deployment of technology at or near commercial scale. That is the reason for our recommended mid-term program of

additional demonstrations (see discussion below). Without this continued activity during a period when little, if any, new coal-fueled power plants are projected to be built, we would lose momentum in maturing the technologies under demonstration. Further, without the prospects of additional commercialization and use, expertise and know-how will rapidly dissipate and infrastructure and even physical resources (sufficient coal resources and capacity to construct) will disappear with significant uncertainty as to whether these resources can be reconstituted.

d. Increased and targeted funding for coal-based technology R&D

This exact same need for financial and policy support for coal technology development exists with respect to continued, robust funding for the government's RD&D programs, particularly those administered by the DOE's Fossil Energy Office and conducted through NETL. That laboratory is focused upon supporting continued improvements in the development of the next generation of coal fueled technologies. These "second generation" technologies as well as "transformational" technologies, according to the conclusions reached in our Roadmap, will be deployed in the 2025 and 2035 timeframe, respectively. These future technologies have the greatest promise toward reducing the cost of CO_2 capture. As the Roadmap suggests, in 2030, if a power facility was reasonably close to an EOR opportunity, the CO_2 could become a valued commodity. In this instance, the levelized cost of electricity (LCOE), assuming we are successful in developing advanced power plants equipped with CO_2 capture(as described in the Roadmap), and selling the CO_2 for EOR, could be decreased significantly to a value of approximately $65/MWh, which is competitive with other low cost sources of electricity.

One important program being supported by the DOE program is the work being done at the National Carbon Capture Center (NCCC) which is successfully identifying and developing new and novel CO_2 capture concepts. Several hundred CO_2 capture possibilities have been catalogued at the NCCC that need to be screened, and where promise exists, NCCC demonstrations conducted. Because of on-going research efforts at this research facility and elsewhere, the earlier prospect of a 35% parasitic penalty (the amount of electricity from the power plant needed to operate the carbon capture system) is now much closer to 20%, with many opportunities to drive this energy penalty even lower.

Another key Roadmap recommendation is a "carbon storage site certification" program to characterize and qualify 5 regionally-diverse sites that can each accept 50 million tons of CO_2 at a rate of 5 million tons per year. Such a program would accelerate the demonstration of permanent CO_2 storage in saline formations and prove out the stability and safety of this method of CO_2 sequestration.

e. ***Limited government and industry resources requires carefully selected areas for support***

We must focus efforts on evaluating, estimating and developing technologies that capture CO_2 affordably. The best, most reliable and efficient technology, if not affordable, will not sustain coal's continued use.

To assure affordability from the end-user's perspective, we must not ignore what the DOE and industry can afford. Restricted budgets are a reality and the Roadmap was developed with the intent of providing guidance as to how limited public funding might be used to maximize the future cost benefits of technology development. This is likely going to involve tough decisions so that the available funding is spent wisely on technologies that have the highest potential for successful widespread commercialization.

f. *Specific Areas of divergence from the FY 2014 budget request*

CURC fully supports the Administration's requests in its FY 2014 budget to continue development of cost-effective technology to capture and use or store CO_2. However, we also believe the FY 2014 Coal R&D budget may be too singularly focused on the development of CCS. There are several other areas of critical technology development that require attention and support.

For example, given the changing nature of the power generation sector and the role of other sources of electricity generation, the program should also focus on technology needs applicable to both the existing and new fleet of coal power plants by addressing improved efficiency, reliability, and flexibility in generation. The program currently lacks any emphasis on needs relevant to the existing fleet except for CO_2 capture.

Other examples of programs that are included in the CURC-EPRI Roadmap but not reflected in the Administration's proposed FY 2014 budget, include a water management program. Such a program should be designed to model water use for a variety of coal technologies as well as to develop technologies to reduce water withdrawal and consumption at power generation facilities.

Given the age of the current power generation fleet in the U.S., there exists a very significant challenge that RD&D be conducted in a timely fashion. Power plant units are aging and by the time many of these technologies are ready for commercial use, the existing coal units may simply be too old for retrofitting new technology or will be candidates for retirement. We must examine the pace of technology development and the ability to apply CCS on these units. We believe that a portion of the existing fleet will be candidates for successfully commercialized CCS technology, but that technology development cannot be postponed or delayed for lack of financial support from the government and industry. Stretching out development time due to lack of funding is not advisable. In this same regard we are concerned that many existing coal units could be retired before DOE is projecting completion of RD&D on transformational technologies such as chemical looping or pressurized oxy combustion and this existing coal fired generating capacity will be replaced with potentially more expensive non-coal fired technologies. If successfully developed in time, these transformational coal fired technologies could be realistic candidates for new power plant applications to replace retiring units. It is therefore very important that there be a serious evaluation of whether DOE's technology portfolio needs to be substantially accelerated to meet real world needs and future opportunities to deploy the next generation of coal-fueled generating units.

Finally, as noted in the CURC/EPRI Roadmap, the DOE program also should support "breakthroughs" in technology R&D across several program areas that encourage revolutionary

approaches to converting coal to useful energy and products. Importantly, the emphasis of this initiative is a focus on new ways to use coal rather than a primary focus on the capture and use, or disposition of CO_2 from coal fired plants. An example of a breakthrough technology might include the substitution of biosystems for current chemical processes. An example of such breakthrough technology might be a genetically engineered microbe that could be used to convert coal to methane or hydrogen, eliminating many sources of pollution and creating a physically more convenient form of energy (see: Attachment D for a depiction of the timelines for technology development in the CURC-EPRI Roadmap).

B.6. Budget Requirements and Implications

Government partnership support and funding commitments are critical to ensure that the goals of the Roadmap are accomplished. In order to achieve the objectives of the Roadmap funding ranging from approximately $465 million per year through 2018, $363 million per year through 2025, and then $189 million per year after 2025 is required. Of this amount, the Roadmap recommends continuation of the current R&D policy of 80% federal and 20% private or other funding for research and development activities. Accordingly, in FY 2014 through FY 2018, the coal R&D program would require $372 million per year in funding from the DOE's coal R&D program. This amount is contrasted to the $316 million that the House recently recommended in coal energy R&D for FY 2014 and the $276 million requested by the Obama Administration for FY 2014.

In summary, the Administration's FY 2014 recommended funding level of $276.6 million and the House's recommendation of $315.9 for Coal Research & Development at the Department of Energy is not sufficient to accomplish the important R&D necessary to support our nation's most abundant and valuable domestic resource.

Congress, and particularly the House of Representatives, over the course of the last several appropriations cycles has recognized the need for additional funding and we would urge such additions in the FY 2014 budget, as well (See: Attachment E for a tabular history of appropriation requests and approved levels of funding for the DOE coal R&D program).

Also, as set forth in the Roadmap, an additional effort will be needed to construct and operate commercial scale projects to demonstrate the best of these R&D products. That demonstration program has an estimated capital cost of about $6.2 billion for demonstration units built through 2025, and another $3.5 billion for demonstrations built between 2026 and 2035. None of this funding for commercial-scale technology demonstrations is currently contemplated through existing federal budgets.

B.7. Strategic Steps Forward

It is useful to step back from the detail of the CURC-EPRI Roadmap and consider coal technology development activities which could accelerate progress in meeting coal's challenges, and ensure that the country continues to enjoy, if not expand, the benefits of using coal. CURC has undertaken such an examination and is recommending that a 3-part program

be considered that consists of discrete activities targeted at the (1) near-term, (2) the mid-term, and (3) the long-term.

a. The near-term program

In the near-term, CURC believes that the key area to address is the existing coal fleet. Given the recent EPA regulations, the expanding need for flexible operation on electricity networks increasingly populated with intermittent renewable electricity generation, and the age profile of the existing coal fleet, it is important to examine existing technologies, including a determination as to whether short-term R&D aimed at compliance and improved efficiency, reliability, and flexible operation would be helpful. In suggesting this effort, CURC recognizes that a major challenge when targeting research for the existing fleet is that R&D on power systems takes time, and the time necessary to develop new compliance options can be greater than the time allowed in regulations to bring sources into compliance.

b. The mid-term program

For the mid-term, CURC recommends two programs be simultaneously undertaken. The first would take advantage of the fact that new CO_2-EOR activities enable oil production, and lead to tax revenues from profits on that oil production which would not happen absent the availability of CO_2. CURC has under consideration a proposal that would operate to provide that a portion of the new tax revenues be used to partially offset the CO_2 capture cost at coal-based power systems linked to EOR. Such a program could enable increased domestic oil production, speed CCS technology development, and provide competitively priced electricity, without increasing tax rates for individuals or industry. Success in this limited program could lead to a greatly expanded national CO_2-EOR program which would function without government assistance – creating a significant number of new jobs, improving the U.S. trade balance, and reducing foreign oil imports.

The second mid-term initiative would deploy high-efficiency coal-based power generation without waiting until complementary CCS systems can reach economic viability. This program, limited to 10 gigawatts of new generation capacity commencing service in the 2020s, would apply only to units which agree to deploy the most efficient plant designs and meet specific environmental performance criteria, with the exception of CO_2. For reducing CO_2 beyond the capability of high-efficiency operation, the plant owners would agree to install CCS technology within a designated period of time after the Secretary of Energy determines that the technology meets an affordability cost criterion, such as a certain $ per megawatt-hour or $ per tonne CO_2 limit.

c. The longer-term program

CURC's longer term activity encompasses the bulk of the CURC-EPRI Roadmap, which must be immediately implemented in order to ensure the technologies are available in the 2025-2030 timeframe contemplated in the Roadmap. We would highlight CURC's proposal for "qualifying" several regionally diverse CO_2 saline storage formations to ease the challenge for early adopters of CCS technologies; the National Carbon Capture Center as a means to test new capture

concepts without the need for time consuming and cost redundant resources for simulating a power plant environment; the need for truly transformational new technologies to minimize the cost of power from coal units with CCS; and the need to expand NETL's scope to consider traditional air and water pollutants, power plant cooling systems, and technologies to improve power plant efficiency.

C. Conclusions

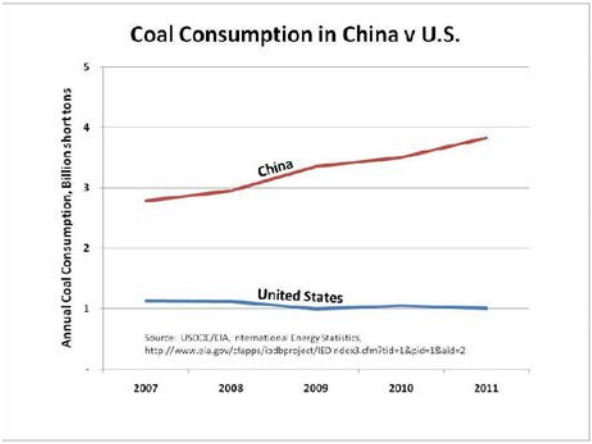
CURC wishes to thank the Committee for the opportunity to provide this statement.

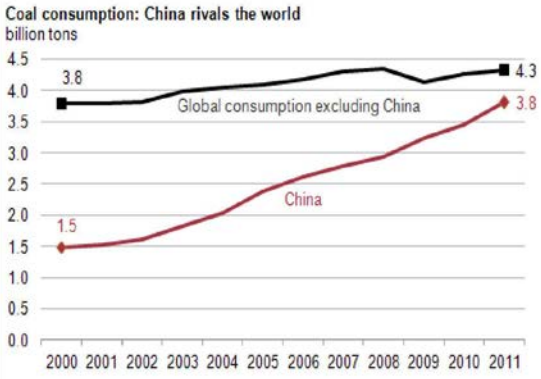
The development and then application of technology has been a key factor to the sustained use of U.S. coal resources. Advanced coal-based technologies, including CCS technologies, if given sufficient time, encouragement and sustained public support will be developed just as technologies for coal have been developed in the past. Thus, any clean energy future for this country can, and should, encompass one of the Nation's most abundant, domestic resources -- coal.

It may be worth reminding ourselves, while we encounter the musings of coal's demise that coal can point to many decades of supporting the Nation's economy, and 40 years of R&D successes in addressing environmental issues. We have cashed the dividends of coal technology investments made by our fathers, and this Committee has the opportunity to make that statement true for our children as well.

Attachment A

Coal Dominates China's Energy Supply

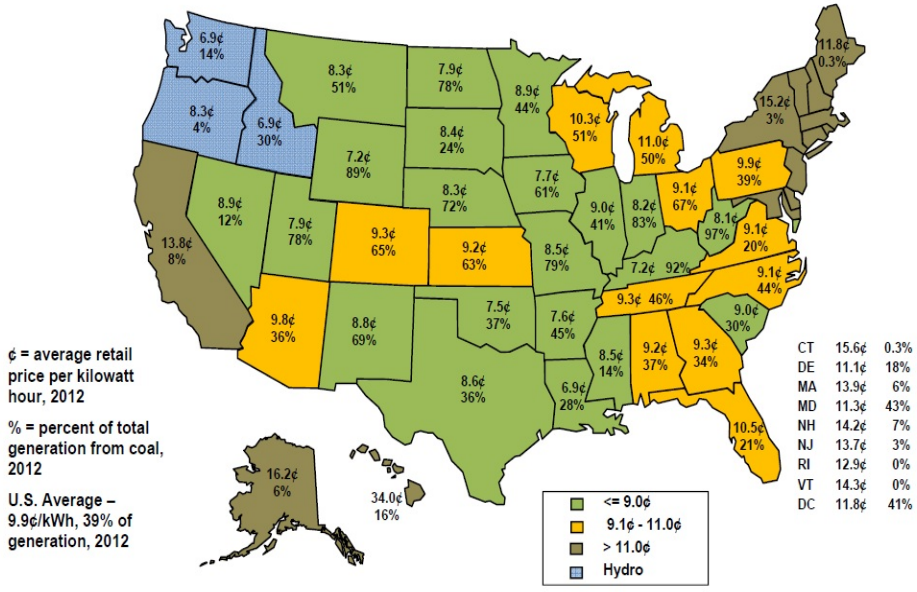




- China accounts for 47% of global coal consumption, almost as much as the rest of the world combined
- In 2011, coal consumption in China grew >9% for the 12th year of an upward trend
- China has 700 GW of installed coal capacity, compared to only 310 GW in U.S.

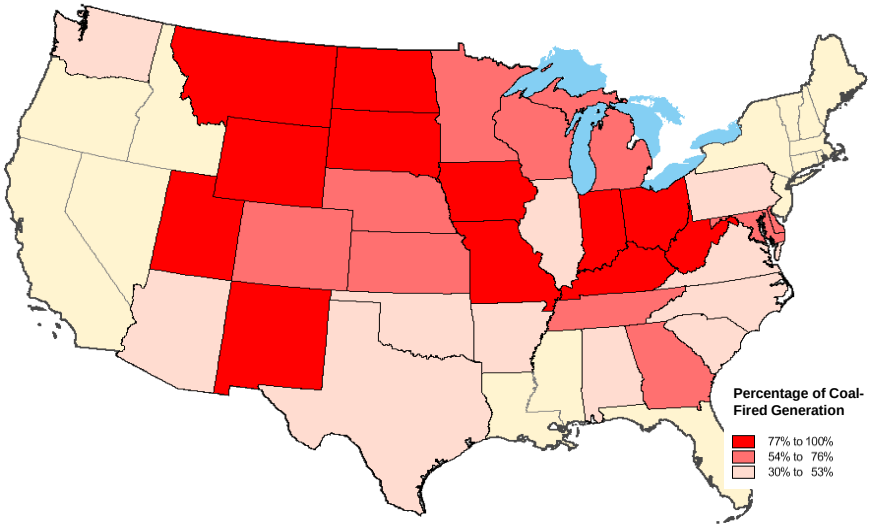
Attachment B

Cost Per kWh & Percent of Coal Power Sector Generation



Sources: Energy Information Administration, *Electric Power Monthly*, March 2013 (2012 data); Public Service Commission of the District of Columbia (2012); California Energy Commission (2011 latest available); Washington State Department of Commerce (2011 latest available). 2012 data are preliminary.

State Coal-Fired Generation Intensity



33 or 50 States produce 30% or more electricity from coal-fired generation

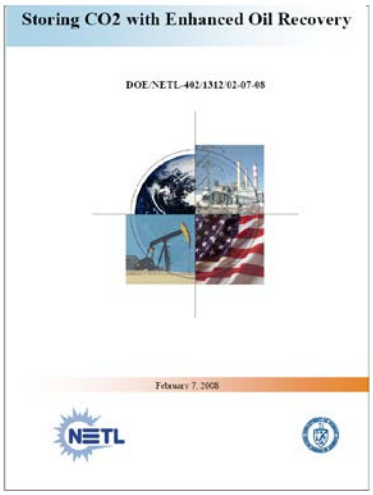
Attachment C

There is a lot of EOR

Table 7. Economically Recoverable Resources from Applying "State-of-the-Art" CO2-EOR: National Totals at Base Case Economics*

Basin/Area	Incremental Technically Recoverable (Billion Barrels)	Incremental Economically Recoverable* (Billion Barrels)
1. Alaska	12.4	9.5
2. California	6.3	5.4
3. Gulf Coast (AL, FL, MS, LA)	7.0	2.2
4. Mid-Continent (OK, AR, KS, NE)	10.6	5.6
5. Illinois/Michigan	1.2	0.5
6. Permian (W TX, NM)	15.9	7.1
7. Rockies (CO,UT,WY)	3.9	1.9
8. Texas, East/Central	17.6	8.3
9. Williston (MT, ND, SD)	2.5	0.5
10. Louisiana Offshore	5.8	3.9
11. Appalachia (WV, OH, KY, PA)	1.6	0.1
Total	84.8	45.0

*Base Case Economics use an oil price of $70 per barrel (constant, real) and a CO2 cost of $45 per metric ton ($2.38/Mcf), delivered at pressure to the field.



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The EOR CO2 demand greatly exceeds natural (cheap) CO_2 supply

Table 13. Economically Feasible Market Demand for CO2 by EOR: NEMS/EMM Power Generation Regions*

NEMS EMM Region	Purchased CO2 Requirements	Natural CO2**	Industrial CO2**		Unmet (Net) Demand for CO2	
	(Tcf)	(Tcf)	(MMcfd)	(Tcf)	(Tcf)	(Million mt)
Region 1 - ECAR	1.1	-	15	***	1.1	58
Region 2 – ERCOT	72.2	25	110	1.2	46.0	2,436
Region 3 – PJM (MAAC)	0.1	-	-	-	0.1	4
Region 4 – MAIN	1.9	-	-	-	1.9	100
Region 5 – MAPP	2.1	-	-	-	2.1	109
Region 6 – NY ISO	-	-	-	-	-	-
Region 7 – NW ISO	-	-	-	-	-	-
Region 8 – Florida	0.2	-	-	-	0.2	9
Region 9 – SERC	40.0	8	-	-	32.0	1,695
Region 10 – SWPP	29.7	5	35	0.4	24.3	1,286
Region 11 – WECC/NWPP	7.8	-	175	1.9	5.9	311
Region 12 – WECC/RMPP	2.3	-	65	0.7	1.6	83
Region 13 – WECC/CA	26.0	-	-	-	26.0	1,377
Region 14 - Alaska	39.6	5	-	-	34.6	1,831
TOTAL U.S.	223.0	43	400	4.2	175.8	9,301
TOTAL Lower-48	183.4	38	400	4.2	141.2	7,470

*Base Case: $70/Bbl oil and $45/mt CO2
**Assumed available to be produced and productively used by the CO2-EOR industry in the next 30 years.
***Less than 0.01 Tcf and thus not included in totals.

That's about 40,000 MW of coal generation for 30 years.

Bottom line: We need another 7.5 B tonnes of CO_2 for EOR.

Key Assumption.

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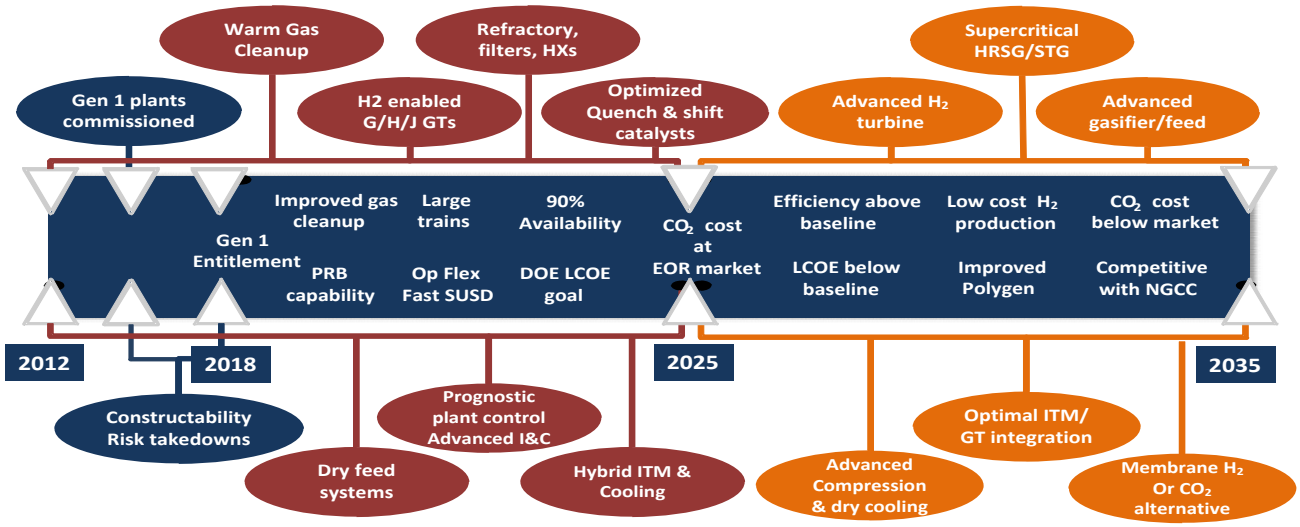
Attachment D

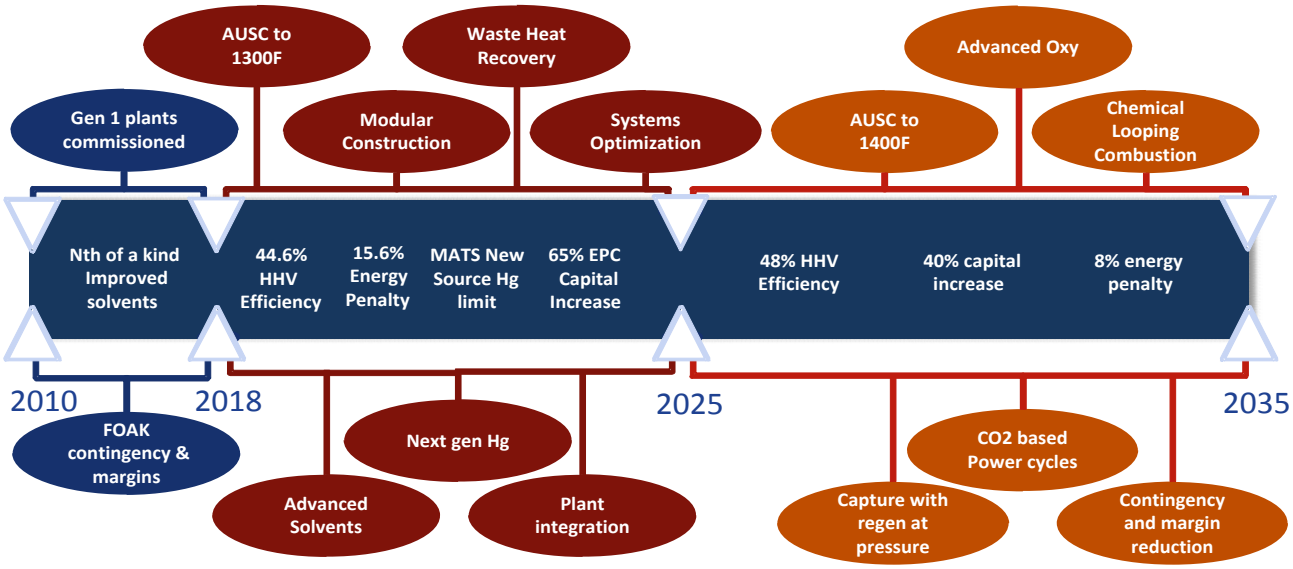
Gasification-related technologies

Gasification Timeline and Impact



Key Combustion-related technologies

Combustion Timeline and Impact



Attachment E

HISTORY OF APPROPRIATIONS REQUESTS AND ENACTED AMOUNTS

DOE CCS & Power Systems Budget ($$ in Thousands)	FY 2008 Request	FY 2008 Omnibus	FY 2009 Request	FY 2009 Omnibus	FY 2010 Request	FY 2010 Enacted	FY 2011 Request	FY 2011 Enacted	FY 2012 Request	FY 2012 Enacted	FY 2013 Request	FY 2013 CR
Coal R&D Program TOTAL	426.5	493.5	623.7	692.4	403.9	404	403.9	390	291.3	360	275.9	370

DOE CCS & Power Systems Budget *($$ in Thousands)*	FY 2014 President's Request	FY 2014 House	FY 2014 Senate	FY 2014 CURC Roadmap
Coal R&D Program TOTAL	276	315	268	404