

**U.S. Department of Energy
Office of Fossil Energy**

Request for Information (RFI)

DE-FOA-0001931

“Coal-Based Power Plants of the Future”

Issue Date: May 8, 2018

Program Area: Office of Fossil Energy (FE); U.S. Department of Energy (DOE)

Purpose:

The purpose of this Request for Information (RFI) is to seek information from power generation equipment manufacturers, utilities, power plant architect-engineers, and other stakeholders that can be used as input to a DOE Fossil Energy Research and Development (R&D) program that may culminate in the design, construction, and operation of a coal-based pilot-scale power plant. The coal-based pilot plant will be used as the basis for scaling up to a commercial offering that is highly efficient (40% or greater higher heating value [HHV]), modular (unit sizes of approximately 50 to 350 MW), and economical for both international and domestic power generation. The pilot plant and commercial offering does not have to capture and store carbon dioxide, but must be carbon capture ready.

This is solely a request for information and is not a Funding Opportunity Announcement (FOA). U.S. DOE is not accepting applications to this RFI.

Background:

Due to ongoing changes in the electricity market, new generating sources must integrate with intermittent power sources and contribute to maintaining reliability and providing ancillary services such as ramping, load following, frequency and voltage management, black start capability, and rapid re-start from warm standby to the plant maximum continuous rating (MCR).

DOE envisions that the coal-fired fleet of the future may be based on power systems with the following characteristics:

- Reduced design, construction, and commissioning schedules from conventional norms
- Modular, maximizing the benefits of high-quality, low-cost shop fabrication to minimize field construction costs and project cycle time
- Designs developed with advanced process engineering and parametric design methods
- Simplified maintenance features
- Integration with energy storage, coal upgrading, or other plant value streams
- Near-zero emissions, including carbon capture ready
- Capable of high ramp rates
- Load following capability down to 25% of MCR
- Minimize water consumption

The new systems will be required to achieve high baseload efficiency (40% HHV or higher) with minimal reductions in efficiency when rapidly cycling through part load conditions, or re-starting from warm

standby. These electric market requirements will need advances beyond today's technology if high plant efficiency is to be achieved over the full range of operating demands.

The traditional areas for achieving coal combustion-based plant efficiency improvements include boiler efficiency, steam cycle efficiency, and reduction of auxiliary power. Each of these areas must consider future plant operating demands.

Opportunities for improving plant efficiency can include:

- Steam cycle efficiency improvements:
 - Develop and demonstrate Advanced Ultra Supercritical steam plants that achieve high efficiency with competitive capital and operating costs
 - Additional steam generation – e.g. advanced feed water heaters, topping cycle features, combined heat and power, integrate with other power cycles (please also see a related RFI (DE-FOA-0001921) issued by the DOE FE Turbines program titled “Performance Improvements for Steam Based Power Cycles in Coal Boilers”)
 - Advanced condensers and cooling tower improvements
 - Reduced pressure drops through steam and water processing and flow path
 - Improved pump efficiency
- Boiler efficiency improvements (greater than 40% HHV efficiency)
 - Boiler design options (e.g. advanced burner/ heat transfer designs/configurations, dual fuel designs, advanced controls, etc.)
 - Reduce unburned carbon loss
- Plant cycle efficiency opportunities
 - Reduce stack losses – e.g. reduce stack temperature, reduce stack moisture, reduce stack flow
 - Additional plant heat integration
 - Advanced instrumentation, controls, and predictive (e.g. condition-based) rather than periodic maintenance
- Auxiliary power reductions
 - Lower excess air
 - Lower pressure drops
 - Improved component efficiencies – e.g. fans, pumps, pulverizers, motors
 - Lower emission control system power requirements

In addition to advances in traditional combustion-based concepts, there are opportunities to achieve efficiency advances through advanced power concepts. Examples include:

- Coal combustion reactors for indirect sCO₂ power cycles
- Plants that produce electricity and other marketable products (e.g., gasification-based plants)

Information Request:

DOE seeks information in response to this RFI that may be used to assist in establishing content for the preparation of future funding opportunity announcements.

Information on concepts and systems related to the following comments and questions are requested. While DOE's preference is that respondents address all number items below, responses that address only a subset of the questions would still be helpful and are welcomed.

1. DOE envisions that the coal plant of the future will have all, or some combination of, the following features:
 - Reduced design, construction, and commissioning schedules from conventional norms
 - Modular, maximizing the benefits of high-quality, low-cost shop fabrication to minimize field construction costs
 - Developed with advanced process engineering and parametric design methods
 - Simplified maintenance features
 - Integration with energy storage, coal upgrading, or other plant value streams
 - Near-zero emissions, including carbon capture ready
 - Achieve a ramp rate of at least 4% of MCR per minute
 - Load following capability down to 25% of MCR
 - Minimize water consumption

Please comment on the salient features of the envisioned modular power plant system and provide your view, assessment, and support for these or other features.

2. DOE has proposed that the power plant must be fueled predominantly with coal (e.g., at least 75% from coal on a fuel input basis), but can be dual fueled. Please comment on this level of coal fueled requirement and estimate the appropriate level of coal fueling of your concept or power plant market offering that would maximize coal production in the U.S. assuming your concept achieved its commercial potential. Please support your answer with analysis.
3. Please explain the limiting factor that determines the smallest size of a modular plant: boiler, heat generator, compressor, turbines, existence of a smart grid etc. Please be very clear with your answers on this as the scale and definition of modular systems requires clarity and can be dependent on the type of feedstock (variety of coals and natural gas). What are the potential sizes of steam turbines (that are either available now or could be commercially available within five years) that could enable an efficient modular coal plant?
4. Please propose a coal-based power plant concept that would have the greatest potential to achieve the stated purpose of this RFI. Responses should provide the following:
 - A description of a proposed coal-based power plant system including the size of the pilot plant and initial commercial offering in MW(e), and order-of-magnitude cost estimates of both the pilot and commercial plant
 - Markets (domestic, Independent System Operator specific, and international) for each application of your plant
 - Market advantage of your modular concept over potential competitors
 - The business case for your power plant system to complete the pilot program that enables a commercial system design in the next 10 years
 - Performance and cost requirements, including the natural gas price needed for the proposed system to achieve economic parity with natural gas fueled systems
 - As applicable, a description of how other fuels will be used in conjunction with coal
 - As applicable, a description of how energy storage would be used
 - As applicable, a description of how the proposed system would be “carbon capture ready”
 - As applicable, a description of how the proposed system would capture carbon dioxide, including the use of advanced carbon capture technologies (e.g. advanced solvents, membranes, sorbents, or other novel/hybrid systems)
 - As applicable, a description of how the proposed system would either utilize or store captured carbon dioxide
 - A simplified block flow diagram of the pilot-scale plant

- Perceived technology gaps and R&D needed to develop and commercialize the proposed system, including a brief description of the R&D, funding and schedule needs
 - An explanation of how the development of this technology could represent a step change in performance, efficiency, and the cost of electricity compared to today's technologies
 - Identification of the most important scaling parameters, integration and scale-up issues
 - Logical steps (i.e., tangible commercial offering or stage/gate accomplishments) required for the development of the system or enhancement that can engender stakeholder support for R&D to address technology gaps and realize commercialization goals.
5. Please comment on the possibility that the proposed power plant system could also work off-grid, be competitive with other market options and provide power, heat/other products, and employment for remote communities in states utilizing coal and natural gas at the source.
 6. What host sites would be suitable for your power plant pilot system to be placed? At a mine-mouth? On Federal lands? Tribal or Native American lands? At existing power plants, or brownfield, or greenfield sites? Are there any environmental or other siting benefits that would be associated with one site over another that would help accelerate the construction and operation of a pilot plant assuming that the pilot plant will not have to meet performance guarantees?
 7. The DOE is currently considering the use of a multi-step development approach to achieve the stated goal of this RFI. This approach includes the following:
 - Complete pre-FEED designs (AACE Class 4) for both the proposed pilot plant and commercial offering, identify critical system components, and define the R&D (if any) required to ready them for pilot-scale testing.
 - Complete development of critical components to ready them for pilot-scale testing.
 - Complete a site-specific FEED study (AACE Class 3) for the pilot plant, including permitting. In parallel, complete a parametric design code that could be used to design similar plants with different characteristics (e.g., ambient conditions, scales, coal types).
 - Construct the pilot plant.
 - Commission and operate the pilot plant (specify total duration or assume nine months) and validate the parametric design code.

Please comment on this development approach and provide order-of-magnitude cost and time estimates that would be needed **for each of these steps for the proposed power plant pilot system.**

8. Recognizing the regulatory requirement for private sector cost share of 20% for research and development projects, for each of the proposed steps in question #7, what level of cost share best represents the level of risk that the private sector would/ could assume? 50%, 20%, or less? Please explain and support your response.
9. What financial barriers are anticipated to be encountered during the design, construction, and operation of a pilot plant and how could they be overcome?
10. What role might you play in a pilot test? Is it as the developer/manufacturer of the system, a systems integrator, and/or host? Please explain.
11. Would your team be willing to partner with others to conduct this modular pilot testing?

12. What is a realistic schedule for securing necessary commitments from all technology providers, engineering/EPC firms, host sites, funding sources, and other anticipated partners in order to design, construct, and operate a pilot facility of this technology?

Request for Information Response Guidelines

Responses to this RFI must be submitted electronically to DE-FOA-0001931@netl.doe.gov with the subject line "DE-FOA-0001931 - RFI" no later than 8:00pm (ET) on June 8, 2018. Responses must be provided as attachments to an email. It is recommended that attachments with file sizes exceeding 25MB be compressed (i.e., zipped) to ensure message delivery. ***Responses must be provided as an Adobe Acrobat PDF (.PDF) attachment to the email, and no more than 10 pages in length, 12 point font, 1 inch margins. Only electronic responses will be accepted.***

The U.S. DOE will not respond to individual submissions or publish publicly a compendium of responses. A response to this RFI will not be viewed as a binding commitment to develop or pursue the project or ideas discussed.

Respondents are requested to provide the following information at the start of their response to this RFI:

- Company / institution name;
- Company / institution contact;
- Contact's address, phone number, and e-mail address.

Please feel free to provide any additional background about yourself or your organization.

On behalf of Transformative Power Generation Team, thank you in advance for providing your input on this important topic and contributing to the U.S. DOE's success in achieving its objectives.

Disclaimer and Important Notes

This RFI is not a Funding Opportunity Announcement (FOA), therefore applications are not being accepted at this time. There is no guarantee that an FOA will be issued as a result of this RFI. Responding to this RFI does not provide any advantage or disadvantage to potential applicants if U.S. DOE chooses to issue a FOA regarding the subject matter.

Any information obtained as a result of this RFI is intended to be used by the Government on a non-attribution basis for planning and strategy development, and for development of topics for a funding opportunity announcement. This RFI does not constitute a formal solicitation for proposals or abstracts. Your response to this notice will be treated as information only. U.S. DOE will review and consider all responses. U.S. DOE will not provide reimbursement for costs incurred in responding to this RFI. Respondents are advised that U.S. DOE is under no obligation to acknowledge receipt of the information received or provide feedback to respondents with respect to any information submitted under this RFI. Responses to this RFI do not bind U.S. DOE to any further actions related to this topic.

Proprietary Information

Because information received in response to this RFI may be used to structure future programs and FOAs and/or otherwise be made available to the public, **respondents are strongly advised to NOT include any information in their responses that might be considered business sensitive, proprietary, or otherwise confidential.** If, however, a respondent chooses to submit business sensitive, proprietary, or otherwise confidential information, it must be clearly and conspicuously marked as such in the response.

Responses containing confidential, proprietary, or privileged information must be conspicuously marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The U.S. Federal Government is not liable for the disclosure or use of unmarked information, and may use or disclose such information for any purpose.

If your response contains confidential, proprietary, or privileged information, you must include a cover sheet marked as follows identifying the specific pages containing confidential, proprietary, or privileged information:

Notice of Restriction on Disclosure and Use of Data:

Pages [List Applicable Pages] of this response may contain confidential, proprietary, or privileged information that is exempt from public disclosure. Such information shall be used or disclosed only for the purposes described in this RFI [DE-FOA-0001931]. The Government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source.

In addition, (1) the header and footer of every page that contains confidential, proprietary, or privileged information must be marked as follows: “Contains Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure” and (2) every line and paragraph containing proprietary, privileged, or trade secret information must be clearly marked with double brackets or highlighting.