

U.S. Department of Energy

Office of Clean Energy Demonstrations

Request for Information: DE-FOA-0003333

**Opportunities to Support Mid-scale Commercial Direct Air
Capture (DAC) Demonstration Facilities**

ISSUE DATE: February 29, 2024

PROGRAM AREA: Office of Clean Energy Demonstrations

RESPONSES DUE: April 25, 2024

Purpose

This is a Request for Information (RFI) issued by the U.S. Department of Energy's (DOE) Office of Clean Energy Demonstrations (OCED). The intent of this RFI is to obtain public input related to the role of mid-scale commercial direct air capture demonstration facilities ("MSC DAC" facilities with capture capacities of approximately 5,000 – 25,000 tons per year) in the DAC industry's commercialization plans. The RFI seeks to understand how any federal funding for these facilities may be most effective in complementing existing Department of Energy DAC programs and accelerating the DAC industry's commercial scale-up, all while considering potential impacts to local communities, including disadvantaged communities.¹

Background

The Office of Clean Energy Demonstrations (OCED) was established in December 2021 to accelerate market adoption of clean energy technologies and fill a critical innovation gap on the path to achieving our nation's climate goals of net zero emissions by 2050. OCED's mission is to deliver clean energy demonstration projects at scale in

¹ The Justice40 Initiative sets a goal that 40% of the overall benefits of certain federal investments flow to disadvantaged communities that are marginalized by underinvestment and overburdened by pollution. The Justice40 Interim Guidance defines benefits as direct and indirect investments (and program outcomes) that positively impact disadvantaged communities and provides examples (Page 4). See OMB, CEQ, & CPO, M-21-28, Interim Implementation Guidance for the Justice40 Initiative (July 20, 2021), <https://www.whitehouse.gov/wp-content/uploads/2021/07/M-21-28.pdf>; see also OMB, CEQ, & CPO, M-23-09, Addendum to the Interim Implementation Guidance for the Justice40 Initiative, M-21-28, on using the Climate and Economic Justice Screening Tool (CEJST) (Jan. 27, 2023), https://www.whitehouse.gov/wp-content/uploads/2023/01/M-23-09_Signed_CEQ_CPO.pdf.

partnership with the private sector to accelerate deployment, market adoption, and the equitable transition to a decarbonized energy system.

OCED is a multi-technology office with funding for demonstrations that include advanced nuclear, clean hydrogen, carbon management, long-duration energy storage, industrial decarbonization, and more. With a clear role in commercializing critical clean energy technologies, OCED fills the gap between the research, development, and early-stage demonstration projects, including those within DOE technology offices, and initial deployments supported by the private sector and/or other DOE programs, such as the Loan Programs Office.

OCED's portfolio in the carbon management sector includes the \$3.5 billion Regional Direct Air Capture (DAC) Hubs program, which it manages in partnership with DOE's Office of Fossil Energy and Carbon Management (FECM). The DAC Hubs program will develop four regional direct air capture hubs, as directed by the Bipartisan Infrastructure Law (BIL). Each will demonstrate a DAC technology or suite of technologies at a commercial scale with the potential for capturing at least 1 million metric tons of carbon dioxide (CO₂) annually from the atmosphere. Once captured, the CO₂ will be permanently stored in a geologic formation or utilized in new products.

The first funding opportunity under the program ([DE-FOA-0002735](#)) was released in December of 2022 and announced over \$1.2 billion to eligible projects. In August 2023, DOE announced the selection of 21 projects for award negotiations across various project readiness levels spanning pre-construction planning, front-end engineering design (FEED) studies, and feasibility studies. Those projects also reflect diversity in aspects of technology, geography, organizational structure, energy inputs, and storage or utilization types, among others.

Description

OCED is evaluating a potential program to support **mid-scale commercial direct air capture demonstration facilities** ("MSC DAC" demonstration facilities). In this context, a "mid-scale commercial demonstration facility" refers to a DAC facility that 1) has a nameplate capture capacity of roughly 5,000 – 25,000 tons of CO₂ per year (TPY), and 2) generates revenue either from the sale of carbon removal credits, the sale of carbon dioxide to an offtake partner for storage or use in a product or fuel, and/or tax credits or other incentives (e.g., 45Q, low carbon fuel standards).

Supporting the design, development, construction, and operation of MSC DAC demonstration facilities could complement existing DOE programs and private sector-led technology commercialization efforts by addressing the gap between the 50,000 TPY minimum defined in the first Regional DAC Hubs FOA and the pilot facilities that are in scope for

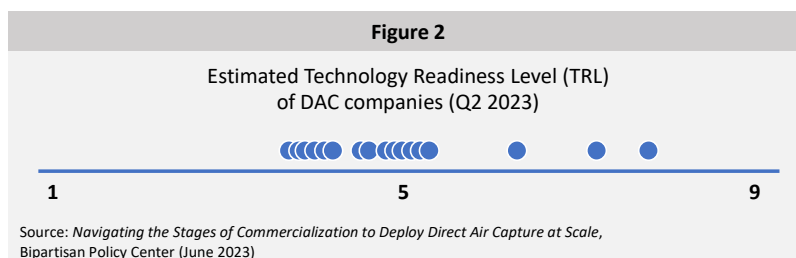
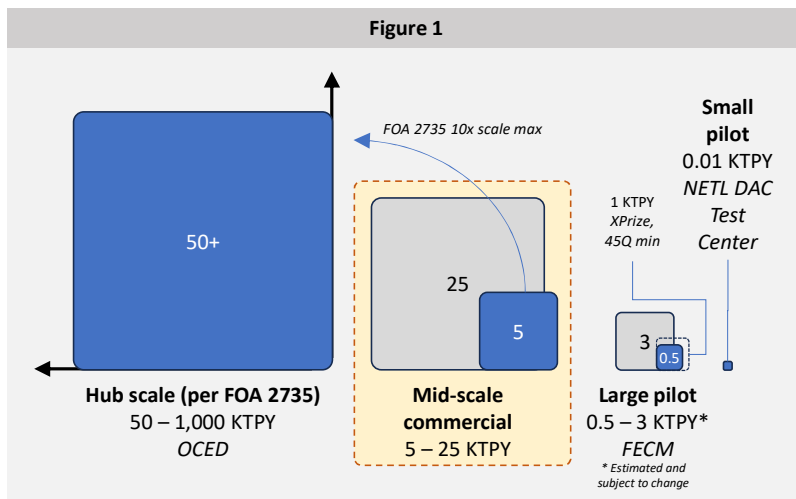
the intended DAC Pilot Prize (from FECM) and DAC Test Center (from the National Energy Technology Laboratory, or NETL). Mid-scale commercial demonstration facilities could be the next logical step for many private sector-led DAC projects once they've completed work in earlier-stage FECM and NETL pilot programs. Such facilities could also provide opportunities for complementary carbon utilization efforts which would benefit from real-world demonstrations at this scale.

In the case of the Regional DAC Hubs program, MSC DAC demonstration facilities could serve to de-risk the technology and commercial aspects of current and future Hub partners as they advance to larger scale (see Figure 1). Support for mid-sized commercial facilities could bridge this public funding gap in the research, development, and demonstration continuum.

A variety of data points, including those that informed DOE's Carbon Management Liftoff Report, and DOE's existing portfolio, support the idea that mid-scale facilities are a key component in many

DAC companies' commercialization strategies. Some DAC technology and project developers have already expressed intent to build a facility at this scale. A recent survey of the field indicates that a sizeable cohort of DAC companies moving into the pilot and demonstration stages are at or approaching Technology Readiness Level (TRL) 6 (see Figure 2).

However, a mid-scale facility may face unique challenges from a business model and investment perspective. Assuming an illustrative capital expense range of \$3,000 –



\$5,000 for every ton of nameplate capture capacity, facilities at the 5,000 – 25,000 TPY scale could cost \$15 million to over \$100 million to build. Some companies may be able to fund a project of that size on their own balance sheet, but many will not have that funding available, or will have a prohibitively high internal cost of capital. Project-level financing would likely be inaccessible without pre-committed sales or offtake contracts. In either case, an MSC DAC facility would need to generate revenue, on top of any available tax credits, to meet investor return requirements.

However, the volume of CO₂ generated at the MSC DAC facility scale may be too low for a commercial CO₂ transportation and storage provider to service. Integrating the CO₂ into a product or fuel may be the only practical option, while opportunities for partnering or co-locating with those utilization offtakers are relatively scarce. Suitable carbon utilization providers may also be small or new operators encountering similar challenges. Similar obstacles may exist in accessing the clean energy inputs necessary to achieve the net carbon reduction or removal required by the revenue model.

Furthermore, there may be diverging preferences among developers of mid-scale facilities on other key project decisions, such as siting and operational lifespan. In some cases, these facilities 1) may be ideally co-located at a site envisioned for a future DAC Hub, 2) may benefit from being sited at a new, independent location, or 3) may prefer to be co-located with a new or existing CO₂ offtaker or energy provider. Operational life may also vary significantly. Some mid-scale facilities may plan to operate for 10+ years, either to recover capital costs or to form part of a larger expanded facility. Some facilities may only operate for a few years and be decommissioned once the next, larger facility is operational.

In summary, mid-scale commercial facilities appear to be an important part of the DAC industry's scaling plans. However, developers face some unique obstacles and a variety of implementation options. Public funding for mid-scale facilities may help overcome these obstacles while complementing and accelerating the success of other DOE programs and advancing the DAC field overall. To confirm the interest in and aid in the potential design of a MSC DAC demonstration facilities program, DOE is seeking public input from industry, investors, developers, academia, research laboratories, government agencies, potentially impacted communities, and other entities on potential projects on their interest, potential structure, benefits, and risks of a MSC DAC demonstration facilities program. DOE welcomes input on the questions below.

Equity, Environmental, and Energy Justice (EEEJ) Priorities

EEEJ principles and priorities will be central to DOE's successful implementation of the BIL. Equity requires the consideration of existing barriers underserved and underrepresented individuals and communities face when accessing Federal resources.

Environmental and energy justice principles include procedural justice, distributive justice, recognition justice, and restorative justice. For the purposes of this RFI, DOE has identified the following non-exhaustive list of policy priorities as examples to guide DOE's implementation of the Justice40 Initiative in disadvantaged communities: (1) decrease energy burden;^{2,3,4} (2) decrease environmental exposure and burdens;⁵ (3) increase access to low-cost capital; (4) increase the clean energy job pipeline and job training for individuals;⁶ (5) increase clean energy enterprise creation (e.g., Socially Disadvantaged Businesses or Enterprises); (6) increase energy democracy, including community ownership and other economic benefits associated with the energy transition; (7) increase parity in clean energy technology access and adoption; and (8) increase energy resilience.

Equity means the consistent and systematic treatment of all individuals in a fair, just, and impartial manner, including individuals who belong to communities that often have been denied such treatment.

Environmental justice means the just treatment and meaningful involvement of all people, regardless of income, race, color, national origin, Tribal affiliation, or disability, in agency decision-making and other Federal activities that affect human health and the environment so that people:

- (i) are fully protected from disproportionate and adverse human health and environmental effects (including risks) and hazards, including those related to climate change, the cumulative impacts of environmental and other burdens, and the legacy of racism or other structural or systemic barriers; and
- (ii) have equitable access to a healthy, sustainable, and resilient environment in which to live, play, work, learn, grow, worship, and engage in cultural and subsistence practices.⁷

² The Initiative for Energy Justice https://iejusa.org/glossary-and-appendix/#glossary_of_terms

³ DOE's LEAD tool illustrates energy burden in U.S. <https://www.energy.gov/eere/slsc/maps/lead-tool>

⁴ Drehtobl, A., Ross, L., and Ayala, R. 2020. How High are Household Energy Burdens? Washington, DC: ACEEE.

⁵ Tessum, C., et al., 2019. Inequity in consumption of goods and services adds to racial-ethnic disparities in air pollution exposure. Proceedings of the National Academy of Sciences.

⁶ DOE's US Energy & Employment Jobs Report (USEER), <https://www.energy.gov/us-energy-employment-jobs-report-useer>; Department of Labor, Civilian Labor Force by Sex, <https://www.dol.gov/agencies/wb/data/facts-over-time/women-in-the-labor-force>

⁷ Executive Order 14096, *Revitalizing Our Nation's Commitment to Environmental Justice for All*, 88 Fed. Reg. 25,251 (April 21, 2023), <https://www.federalregister.gov/documents/2023/04/26/2023-08955/revitalizing-our-nations-commitment-to-environmental-justice-for-all>.

Energy justice refers to DOE's goal of achieving equity in both the social and economic participation in the energy system, while also remediating social, economic, and health burdens on those disproportionately harmed by the energy system.⁸

Request for Information Response Guidelines

Responses to this RFI must be submitted electronically to *DAC-RFI-OCED@hq.doe.gov* no later than **5:00pm (ET) on April 25, 2024**. 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 a Portable Document Format (.pdf) attachment to the email, and no more than 20 pages in length, 12-point font, 1-inch margins. Only electronic responses will be accepted.

Please identify your answers by responding to a specific question or topic if applicable. **Respondents may answer as many or as few questions as they wish; however, questions in Category 2 are intended only for direct air capture technology/project developers.**

OCED will not respond to individual submissions. A response to this RFI will not be viewed as a binding commitment to develop or pursue the project or ideas discussed.

OCED may publicly share a summary of the responses in written, webinar, or other formats. Any information that OCED chooses to share publicly will be aggregated and/or anonymized to the greatest extent possible. DOE takes very seriously the confidentiality of third-party information and will treat information submitted/received as confidential to the fullest extent permissible under Federal law, including the Freedom of Information Act (FOIA). **Please refer to the Proprietary Information section below for instructions on marking of any proprietary or confidential information.**

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

- Company / institution name and type of organization;
- Indication if company / institution is a DAC technology or project developer;
- Company / institution point of contact;
- Contact's address, phone number, and e-mail address.

⁸ [*How Energy Justice, Presidential Initiatives, and Executive Orders Shape Equity at DOE*](#), Office of Energy Justice and Equity (January 3, 2022)

Request for Information Categories and Questions

Category 1: Questions for all respondents

(Note: all questions are optional)

1. Are DOE's views on the need for public funding to support mid-scale DAC facilities generally accurate? Please provide a yes or no answer and elaborate on the reason.
2. Has DOE accurately reflected the *description* of a mid-scale commercial (MSC) DAC facility?
3. Does DOE's estimate of \$3,000 - \$5,000 of capital expense per ton of nameplate capture capacity accurately reflect the *cost* of developing MSC DAC facilities? Please provide a yes or no answer and elaborate on the reason.
4. Has DOE accurately reflected the challenges related to *financing* MSC DAC facilities? Please provide a yes or no answer and elaborate on the reason.
5. Has DOE accurately reflected the challenges related to finding and accessing *storage and utilization* for MSC DAC facilities? Please provide a yes or no answer and elaborate on the reason.
6. Has DOE accurately reflected the challenges related to *siting and operating* MSC DAC facilities? Please provide a yes or no answer and elaborate on the reason.
7. What challenges related to MSC DAC facilities were not addressed? In what ways could DOE support MSC DAC facilities that were not mentioned?
8. How would a future program most effectively support MSC DAC demonstration facilities? Please address total funding amount, cost share percentage, requirements for facility operational life, specific technology types, or other topics that may help further define a future DOE program.
9. What timing and frequency would be most effective for DOE to offer funding for MSC DAC demonstration facilities? (e.g., a specific calendar year, recurring offerings in multiple years, rolling applications)
10. Are there more effective ways DOE could support the direct air capture field that would be higher priorities than MSC DAC facilities?
11. Would it be advantageous for DOE to fund shared facilities offering DAC developers access to clean energy and CO₂ offtake, where a mid-scale facility

could be built, *in lieu of* funding that directly supports the DAC facility's development and construction?

Category 2: Questions for DAC technology or project developers only

(Note: all questions are optional)

12. Do you envision a mid-scale commercial facility, as described above, as part of your future scaling plans? If not, why not?

13. If Yes to the question above:

- a. At what stage is this facility currently? [Concept; pre-FEED, FEED, project development, construction]
- b. What are the biggest obstacles to this facility's development?
- c. What are the estimated costs of developing and constructing the facility? Does that estimate include expenses related to construction of storage, utilization, or energy infrastructure?
- d. What are the likely revenue sources from this facility? Would this facility be expected to entirely cover its operating expenses from those revenues?
- e. Would the CO₂ generated from this facility be stored geologically, utilized in products, or both?
- f. Would you likely seek federal funding for this facility if a program to support MSC DAC facilities were offered? In what calendar year(s) would funding be most beneficial? At what stage (e.g., FEED, project development) would your project be at that time?
- g. Please describe your level of familiarity with the National Environmental Policy Act (NEPA) and the potential timelines associated with the NEPA review that would be required to receive federal funding?
- h. Please describe any current or potential affiliation between this facility and a project selected for negotiation under the Regional DAC Hubs FOA 2735, or potential affiliation with a future DAC Hub.
- i. Please describe how this facility fits into your broader technology commercialization plans.

- j. If funding for the MSC DAC facility required either permanent storage in a geologic formation or utilization in new products, would this requirement be prohibitive to your seeking of the funding?
- 14. What is the current TRL of your technology and how did you achieve that TRL? What is the scale (i.e., annual capture capacity in tons per year), test conditions, and number of testing cycles at your current TRL?
- 15. Would you plan to list this project on the DOE's Carbon Matchmaker site? If so, at what project stage would you list? If not, why not?

Category 3: Questions for all respondents to answer as relevant to their role

(Note: all questions are optional)

Community and Labor Engagement, Benefits, and Impacts

- 16. In what ways, if any, do you anticipate this program could impact the workforce? For example:
 - a. To what extent do you anticipate job creation, loss, or changes in job quality?
 - b. To what extent do you anticipate the creation of construction jobs? Ongoing operations and maintenance jobs? Other jobs across the supply chain?
- 17. What existing workforce education and training efforts (e.g., specific registered apprenticeship programs, labor management training programs, community college or technical school programs, etc.) are preparing workers for this industry? How can those efforts be best supported or augmented for ensure success of this industry?
- 18. What specific criteria should DOE use to evaluate and select applicants for a MSC DAC program based on support for quality jobs, including criteria regarding wages and benefits, training and workforce development, worker health and safety, formal agreements to deliver benefits to workers and communities, respect for workers' free and fair chance to join a union, and other criteria to implement the Good Jobs Principles outlined by the Department of Labor?
- 19. What specific criteria should DOE use to evaluate and select applicants for a MSC DAC program based on support for equitable access to jobs and other economic benefits, including the use of hiring, training, evaluation, and other

workplace practices that advance Diversity, Equity, Inclusion, and Accessibility goals?

20. In what way could scaling this industry provide opportunities for workers displaced from fossil industries and other industrial or resource-based industries in decline?
21. What are the key equity-aligned review criteria that DOE should use to evaluate and select applicants for a MSC DAC program?

Equity, Environmental, and Energy Justice

22. What equity, environmental, and/or energy justice concerns or priorities are most relevant for an MSC DAC program? How can/have these concerns or priorities be/been addressed?
23. Describe possible human health, environmental or ecological considerations, both positive and negative (e.g., are there any air quality impacts, impacts on sensitive ecosystems, impacts on communities with environmental justice concerns, other considerations) in connection with implementation of this program.
24. How can adverse impacts be measured or monitored, and which materials/processes/components may result in the largest environmental impact? What opportunities exist to minimize impacts?
25. What information do communities, Tribal or State governments, or entities/organizations need to engage with the Department on MSC DAC?
26. What benefits or opportunities could encourage local, State, and Tribal governments to consider engaging with the Department?
27. How should the Department better engage local, State, and Tribal communities to establish reasonable expectations and plans concerning MSC DAC?
28. What organizations, universities, or communities should the Department consider partnering with to develop MSC DAC?
29. What are the key equity-aligned review criteria that DOE should use to evaluate and select MSC DAC?
30. How can OCED ensure community-based entities/organizations are engaged and included in the planning, decision-making, and implementation processes

(e.g., including community-based organizations on the program/project/activity team)?

31. What barriers exist, if any, for deeper economic and other engagement with communities impacted by this program/project/activity?
32. DOE requires Community Benefits Plans (CBPs) as part of all BIL and IRA funding opportunity announcements. CBPs are based on four core policy priorities: engaging communities and labor; investing in America's workforce; advancing diversity, equity, inclusion, and accessibility; and implementing the Justice40 Initiative. Please give input on how CBPs for MSC DAC can support the identification and implementation of benefits to local communities, including disadvantaged communities.
33. Please clearly articulate, with concrete actions, how regional economic growth and its benefits will be shared with underserved populations.
34. Please describe any issues that should be addressed to enable the equitable implementation of the MSC DAC?
35. How are Tribal communities or lands impacted by MSC DAC?
36. What are the demographics of the area immediately surrounding the program/project/activity site and what are the characteristics of the area immediately surrounding the site (e.g., residential, industrial, rural, urban)?
37. What factors should be considered when identifying and selecting the location of the technology/project/activity (e.g., economic considerations, policy considerations, environmental and energy justice considerations, geology, workforce availability and skills, current industrial and other relevant infrastructure and storage available/repurposed/reused, industry partners, Socially Disadvantaged Businesses or Enterprises, regional specific resources, security of supply, climate risk, etc.)?

Disclaimer and Important Notes

This RFI is not a Funding Opportunity Announcement (FOA); therefore, OCED is not accepting applications at this time. OCED may issue a FOA in the future based on or related to the content and responses to this RFI; however, OCED may also elect not to issue a FOA. There is no guarantee that a 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 OCED chooses to issue a FOA regarding the subject matter. Final details,

including the anticipated award size, quantity, and timing of OCED funded awards, will be subject to Congressional appropriations and direction.

Any information obtained because of this RFI is intended to be used by the Government on a non-attribution basis for planning and strategy development; this RFI does not constitute a formal solicitation for proposals or abstracts. Your response to this notice will be treated as information only. OCED will review and consider all responses in its formulation of program strategies for the identified materials of interest that are the subject of this request. OCED will not provide reimbursement for costs incurred in responding to this RFI. Respondents are advised that OCED 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 OCED to any further actions related to this topic.

Evaluation and Administration by Federal and Non-Federal Personnel

Federal employees are subject to the non-disclosure requirements of a criminal statute, the Trade Secrets Act, 18 USC 1905. The Government may seek the advice of qualified non-Federal personnel. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The respondents, by submitting their response, consent to OCED providing their response to non-Federal parties. Non-Federal parties given access to responses must be subject to an appropriate obligation of confidentiality prior to being given the access. Submissions may be reviewed by support contractors and private consultants.

Proprietary Information

When submitting proprietary and confidential information to OCED, regardless of purpose, respondents must clearly identify and mark any information they treat as confidential/proprietary in the proper manner as outlined below. DOE takes very seriously the confidentiality of third-party information and will treat information submitted/received as confidential to the fullest extent permissible under Federal law. DOE will not be able to protect information that is in the public domain or that a respondent has previously released publicly. For additional information on DOE's FOIA regulations, see 10 CFR Part 1004.

If a respondent includes trade secrets or information that is commercial or financial, or information that is confidential or privileged, it is furnished to the Government in confidence with the understanding that the information shall be used or disclosed only for the intended reasons for submission. Such information will be withheld from public disclosure to the extent permitted by law, including the Freedom of Information Act (FOIA). Without assuming any liability for inadvertent disclosure, DOE will seek to limit disclosure of such information to its employees and to others only when necessary for a prior identified specific purpose or as otherwise authorized by law. This restriction does not limit the Government's right to use the information if it is obtained from another source.

Responses/submissions containing confidential, proprietary, or privileged information must be 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. Government is not liable for the disclosure or use of unmarked information and may use or disclose such information for any purpose.

Respondents should use a cover sheet or otherwise include on the first page of their response submission the following notice, including identifying the specific pages containing trade secrets, confidential, proprietary, or privileged information:

Notice of Restriction on Disclosure and Use of Data:

Pages [list applicable pages] of this document may contain trade secrets, confidential, proprietary, or privileged information that is exempt from public disclosure. Such information shall be used or disclosed only for its intended purposes, for evaluation purposes, or in accordance with a financial assistance or loan agreement between the submitter and the Government. The Government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source. [End of Notice]

The header and footer of every page that contains confidential, proprietary, or privileged information must be marked as follows: “Contains Trade Secrets, Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure.” In addition, each line or paragraph containing proprietary, privileged, or trade secret information must be clearly marked with double brackets or highlighting. To the greatest extent possible, submitters should refrain from marking entire pages/documents as confidential as FOIA Exemption 4 may only be used on truly confidential/proprietary information and excessive unnecessary markings will result in additional disclosures where appropriate.