U.S. Senate Committee on Energy and Natural Resources
October 19, 2021 Hearing: The Phillips, Crabtree, and Sams Nominations
Questions for the Record Submitted to Mr. Brad J. Crabtree

Questions from Ranking Member John Barrasso

Question 1: A. Do you support enhanced oil recovery and its proven ability to permanently store carbon dioxide? **B.** Will you implement the programs that Congress has enacted to promote enhanced oil recovery?

A. Yes. Enhanced oil recovery (EOR) that uses anthropogenic CO2 and incorporates required monitoring, reporting and verification is a proven pathway for geologic storage and is regulated by the U.S. Environmental Protection Agency as such. However, enhanced oil recovery is a fully commercial practice, and DOE is appropriately focused on developing additional commercial applications and solutions for geologic storage and helping get them to a commercial stage (e.g., CO2 storage in saline formations, depleted oil and gas reservoirs, and natural CO2 domes, as well as mineralization in basalts and other geologies). There are many areas where we could leverage our understanding of EOR in terms of its CO2 properties and handling, in addition to geological site characterization and CO2 storage capacity.
B. Within FECM, and DOE at large, the focus is on investment in R&D and ultimately the demonstration of technology that has yet to become fully commercial. If confirmed, I will support and execute authorizations and appropriations as directed by Congress.

Question 2: Does enhanced oil recovery have a lower carbon footprint than other oil production?

CO2-enhanced oil recovery can have a lower carbon footprint than conventional oil production under certain circumstances, and only if anthropogenic CO2 is used in the process. However, the majority of the CO2 currently used for EOR is sourced naturally from geologic domes, not captured from industrial facilities, power plants or ambient air.

Question 3: A. On balance, does U.S. oil production have a lower carbon footprint than oil produced elsewhere? **B.** If so, shouldn't we promote the production and use of lower carbon U.S. oil as an alternative to foreign oil?

A. The carbon footprint of US oil production varies widely by region and depends on a number of factors, including the type of oil produced and the production process, methane leakage, flared or vented gas, and abandoned or orphan wells that may be leaking, etc. FECM is focused on investing in technologies that reduce both the environmental and climate impacts of fossil fuel production, refining and processing, and distribution in the US.
B. Yes, we should promote the development and commercial application of technologies to reduce the environmental and climate impacts of oil and gas production and use, and FECM invests in technologies that minimize such impacts.

Question 4: Do you believe the Department should reissue the National Coal Council's charter?

I had the privilege of serving on the National Coal Council, having been appointed by former Secretary Moniz given my background in carbon management and climate policy and then reappointed by former Secretary Perry. I look forward to learning more about the status of NCC's charter if I am confirmed and join DOE.

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Question 5: The Energy Information Administration recently reported that rising natural gas prices, particularly in Asia and in regions that rely on liquefied natural gas (LNG) imports, are likely to make "coal the most economical generation fuel to pair with increased intermittent generation from wind and solar." Coal remains the world's leading fuel for electricity generation. Much of the coal-fired power plant fleet in Asia is new and still expanding. **A.** Do you support advancing U.S. carbon capture utilization and sequestration (CCUS) technology that can be applied to existing power plants? **B.** Do you believe some applications of CCUS are more important than others? For example, is CCUS applications for industrial sources more important than CCUS applications for electric generation facilities?

A: Yes, I am committed to advancing efforts to reach net-zero GHG emissions and ensuring that robust and reliable technologies are available to do so. Recognizing that many of the nation's existing power plants are fossil fuel-fired, I believe that successful commercial demonstration and deployment of CCS in the power sector would leverage technology that can be applied to existing power plants in the U.S. and in emerging economies in Asia and other regions of the world.
B: While economywide emissions reductions are critical, some applications of CCS are much less developed than others, or not yet commercially deployed at all in some industry sectors, and thus less able to deliver those important emissions reductions. As such, some CCS applications are higher priorities for RDD&D.

Question 6: Global demand for coal, natural gas, and oil, is expected to increase in coming decades. Do you believe the U.S. should remain a leader in the production of these fuels and the carbon management technologies associated with them?

Yes, I believe the US should remain a leader in responsible and sustainable approaches to fossil fuels and that widespread commercial deployment of carbon management technologies is essential to maintaining that leadership.

Question 7: To what extent, if at all, have the recent events in the European energy markets shaped your thinking about the need for dispatchable electric generation in this country?

A: The availability and affordability of reliable electric power is critical to our nation's economy and well-being. We need to support a broad range of low- and zero-carbon technologies, including of course firm dispatchable sources of electric power, which can be fueled by fossil or biomass sources with carbon capture and storage, nuclear, hydropower, or geothermal, all essential complements to continued development and integration of variable sources of clean generation on the grid. At the same time, we must take care to carefully manage both environmental and climate impacts that subsequently result from the extraction and use of fossil fuels to meet our energy needs.

In addition to CCS, when it comes to natural gas, FECM is focused on helping to ensure a leak-tight natural gas system, and conducting research on ways to detect, quantify, and mitigate methane leaks along the natural gas supply chain, all of which will enhance the potential to achieve net-zero emissions in the power sector.

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Question 8: In your view, should CCUS technologies installed on all types of greenhouse gas emitting sources, including electric generation and industrial sources, be considered to be in compliance with environmental, social, and governance standards?

A: Avoiding emissions of CO2 to the atmosphere is critical to reaching Administration goals of a decarbonized power sector by 2035 and economywide net zero greenhouse gas emissions by 2050. Thus, industrial facilities and power plants that emit greenhouse gas emissions will need to identify and implement methods to avoid such emissions, and CCS is one of the crucial pathways available for accomplishing decarbonization.

Question 9: The Department of Energy's Office of Fossil Energy and Carbon Management oversees LNG export authorizations. **A.** Do LNG exports support thousands of American jobs, including thousands of union jobs? **B.** Do LNG exports generate millions of dollars in local, state, and federal tax and other revenue?

A. Yes, the development of LNG export facilities supports many high-wage jobs.
B. Yes.

Question 10: The Department of Energy's Office of Fossil Energy and Carbon Management oversees LNG export authorizations. **A.** Do you believe exporting U.S. LNG to our allies and trading partners has enabled them and continues to enable them to reduce their own greenhouse gas emissions? **B.** Do you believe U.S. LNG exports help our nation's allies and trading partners reduce their own economic and political dependence on our nation's adversaries, like Russia?

A. Yes, there can be benefits from the increased use of natural gas and LNG from both an energy security and comparative emissions perspective. Switching from coal to natural gas has helped reduce energy-related carbon emissions, but these benefits must be considered with any potential impacts on the long-term domestic cost of natural gas. Both the environmental impacts and carbon footprint of natural gas must also be carefully managed, a priority that will become more important as the U.S. and the world continue to expand renewable power generation and look to decarbonized natural gas power generation to support the growth of renewables on the grid.

B. Yes, our place as a global energy supplier of traditional forms of energy, including LNG, advances the energy security of our nation and our allies and trading partners and helps to provide increased access to a less carbon intensive fuel than alternative energy supplies that many countries otherwise rely on. However, I also recognize that there is much work to be done to improve the environmental performance and reduce the carbon footprint of the U.S. natural gas supply chain, and those improvements will be critical for the long-term success of U.S. LNG exports and to achieving our net zero goals. FECM invests in technologies that minimize environmental impacts of fossil fuel extraction such as induced seismicity, produced water, and methane leakage.

Question 11: DOE's June 21, 2018 Policy Statement reads as follows: "DOE stands behind the long-term authorizations it has issued under the Natural Gas Act, approving the export of natural gas, including LNG... DOE is firmly committed to the durability and stability of the [LNG] authorizations it has granted to date, and

to any export authorizations issued by DOE in the future." Do you believe it is important for the U.S. to honor the sanctity of contracts and remain a dependable trading partner?

A: Yes.

Question 12: The Natural Gas Act states that DOE shall issue an order for the export of natural gas "unless, after opportunity for hearing, it finds that the proposed exportation will not be consistent with the public interest." Do you support the presumption in existing law that U.S. LNG exports are in the public interest?

A: It is my understanding that DOE applies the standard set forth in section 3(a) of the Natural Gas Act (NGA), and that there is a presumption that a proposed export is in the public interest. It is also my understanding that this has been consistently applied, and that the U.S. Court of Appeals for the District of Columbia Circuit has affirmed this position, and I agree with this application of the law.

Question 13: The Office of Fossil Energy and Carbon Management is directed, by statute, to support research to improve U.S. oil, natural gas, and coal production. If confirmed, what specific steps will you take to improve U.S. oil, natural gas, and coal production?

A: I am committed to supporting research consistent with statutory requirements and other direction from Congress. As you know, research conducted by FECM played a key role in establishing the U.S. as a global leader in the responsible production of oil and natural gas. I look forward to working with policymakers, industry, academia, NGOs, and other stakeholders to reduce climate and other environmental impacts associated with these fuels, while creating jobs and other opportunities for workers and communities that rely on existing energy and industrial production. If confirmed, I will work to reduce methane emissions across the natural gas supply chain, create new technologies and solutions to reduce flaring, leverage FECM's expertise to support the development of blue hydrogen, and support the growth of renewable energy sources by extracting critical minerals from oil, natural gas, and coal waste streams while remediating some of the legacy impacts of past production activities. All of these are critical areas of work for the future of fossil fuels in a decarbonizing world.

Questions from Senator James E. Risch

Question 1: The Secretary's first Energy Earthshot is to reduce the cost of hydrogen. Researchers at the Idaho National Laboratory, the National Energy Technology Lab (NETL), and the National Renewable Energy Laboratory (NREL) are collaborating on integrated energy systems that will use and electricity from nuclear energy and other technologies to produce electricity and hydrogen. How do these national laboratory collaborations fit in with the departments goals for the Hydrogen Shot, and will you work with the Office of Nuclear Energy and the Office of Energy Efficiency and Renewable Energy to support the collaborations between their applied energy labs?

A: National laboratory collaborations are an important component of DOE goals for the Hydrogen Shot. DOE FECM works closely with the national labs, NE, and EERE with respect to hydrogen, including related to the Hydrogen Earthshot, and I will continue this work and support for collaborations with the applied energy labs.

Question 2 The Office of Nuclear Energy, via the Integrated Energy Systems program, is evaluating carbon conversion pathways that could utilize clean heat and electricity from advanced nuclear plants to upgrade traditional fossil resources, such as coal, to higher value consumer products. How might you foresee collaborating with NE on these pathways that could offer significant opportunity for economic growth in the communities that will be hardest hit by the energy transition?

A: DOE sees an opportunity to engage NE with the Carbon Ore, Rare Earth, and Critical Mineral (CORE-CM) Initiative. This regional approach will help identify opportunities for economic growth in the communities that will be hardest hit by the energy transition. In addition, there could also be an opportunity to collaborate with NE on technology development for producing a broad range of high-value carbon products (carbon fiber, graphene, nanomaterials, graphite and housing/infrastructure) and expanding these products into new markets. While ensuring that processing and manufacturing technologies are safe for workers and all products are safe for end-users, this effort will bring new markets and jobs to these same communities. I also support DOE's efforts with the Interagency Working Group on Coal and Power Plant Communities and Economic Revitalization, including via the Community Local Energy Action Program (LEAP) Pilot that will provide supportive services valued at up to $16M for community-driven clean energy transitions to low-income and high energy burden communities that are also experiencing either direct environmental justice impacts or direct economic impacts from a shift away from historical reliance on fossil fuels.

Question 3: There are several studies under way that consider repurposing existing coal-fired plants to support deployment of advanced nuclear. Can you share your position on coal plant conversion/utilization?

A: I am committed to supporting communities through the clean energy transition, including through the IWG and Community LEAP efforts described above. In some cases, coal plant conversion/utilization might be appropriate fits for power plant host communities, for nuclear or other technologies, and I am committed to working with communities to identify opportunities.

Question 4: I understand that one of the key challenges to carbon capture, particularly direct air capture, is cost. Do you think that there is a role for using waste heat from thermal generation plants, such as a non-emitting nuclear plant, to drive down cost to make carbon capture more economically feasible?

Yes. I am pleased that on October 26, FECM, in collaboration with NE and EERE's Geothermal Technology Office, issued a Funding Opportunity Announcement to support front-end engineering design studies of direct air capture combined with dedicated storage and coupled to existing low-carbon energy.

Questions from Senator Steve Daines

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Question 1: CCUS technology is an important tool for the reduction of carbon emissions. This committee has passed and signed into law numerous CCUS related bills that have direct instructions to DOE. One of those bills created a large-scale pilot project at an existing coal or natural gas plant. I believe Montana is uniquely qualified to host one of these DOE projects. Will you commit to working with me on finding ways for DOE to be more involved with CCUS development in Montana?

A: I am committed to meeting statutory requirements and following Administration guidance in enacting its RDD&D activities, including CCS. I am also committed to ensuring DOE FECM is a resource for carbon management across the United States, including in the area of CCUS development.

Question 2: What hurdles remain in the way of CCUS technology becoming widely commercially available throughout the U.S. and what role will DOE play in removing those hurdles?

A: Commercial adoption of CCS is being accelerated by the RD&D efforts that DOE FECM is supporting as well as incentives like the 45Q tax credits, but more work is needed to demonstrate some of the advanced technologies that are reducing costs and developing the infrastructure required for the transport and storage of carbon dioxide (CO2) in geologic formations. FECM is supporting small and large pilots for advanced carbon capture technologies and front-end engineering and design (FEED) studies of technologies that are ready for commercial deployment. FECM is also supporting the design and development of commercial geologic storage facilities under its CarbonSAFE program in partnership with industry. These efforts also include the planning and design of the CO2 transportation pipeline infrastructure needed to move the CO2 from points sources to the network of storage facilities being planned around the country. Most importantly, there is a need to build and operate full scale demonstration projects and support the development of geologic storage and regional pipelines that could leverage these existing FECM investments in new capture technologies and geologic storage and transport infrastructure resources. Incentives such as the 45Q tax credits have also accelerated the industry's efforts to plan and implement several commercial facilities around the United States. The current 45Q tax credits support some of the most attractive CCS projects but modifications and extensions of these credits may be necessary to continue the deployment of CCS at the scale necessary to decarbonize the U.S. economy.

Question 3: Outside of CCUS technology, where else can DOE play a role to reduce carbon emissions through innovation?

A: Across its offices, DOE is deeply engaged in innovations in clean energy, advanced manufacturing, energy efficiency, and other efforts. One priority of FECM that can be of tremendous value in the short term is developing technologies and solutions to detect and mitigate methane emissions. This includes new sensors, platforms, and analytical tools that can assist industry in finding and eliminating these emissions.

Question 4: Do you believe that coal, oil and gas should play a long-term role in the generation of power in the United States?

A: There are many pathways to meeting the Administration's goal of net-zero emissions in the power sector by 2035. As we continue to rely on fossil fuels, we need to invest in minimizing their environmental and climate impacts across their entire value chain, from production to refining and processing to transport and end use. FECM prioritizes investments in making fossil fuels more sustainable through carbon management and addressing supply chain considerations.

Question 5: Do you believe that CCUS utilizing enhanced oil recovery as a storage solution helps reduce the cost of CCUS deployment and results in increased carbon storage?

A: Enhanced oil recovery using anthropogenic CO2 and incorporating required monitoring, reporting and verification can provide for secure geologic storage. However, the majority of the CO2 currently used for EOR is sourced naturally from the geologic domes, not captured from anthropogenic sources such as industrial facilities or power plants. Investing in transition strategies that lead to anthropogenic CO2 use in place of naturally-sourced CO2 could ultimately lead to CO2 reductions for those facilities from which the CO2 is captured, in addition to reducing their costs for capture.

Question 6: Do you believe that it is in the interest of the U.S. and consumers to have a diverse and balanced energy portfolio that utilizes renewable, fossil and nuclear energy to provide a stable and reliable electric grid?

A: Yes, a diverse and balanced energy portfolio is in the interests of the U.S. and consumers. And the FECM's RDD&D programs and investments can contribute directly to maintaining a stable and reliable electric grid that can achieve full decarbonization by 2035.

Questions from Senator Angus S. King, Jr.

Question 1: I have made my concerns clear for years about the potential impacts that unmitigated LNG exports could have on domestic gas prices, but now we're seeing it happen before our eyes. Domestic gas prices have doubled from a year ago at the same time as U.S. exports of LNG have hit record levels and significant new export capacity is also under construction.

I understand that other countries have experienced difficulties balancing natural gas exports with domestic demand, but the Australian government, for example, established a domestic gas security mechanism which authorizes the government to limit LNG exports if companies are exporting more than they are supplying to the domestic market.

a. Should the Department of Energy have a similar security mechanism in place or is this something that the Department would consider instituting to protect domestic consumers?

It is my understanding that the increase in the domestic price of natural gas has to do with multiple factors, including a lack of U.S. production coming back online from shutdowns that occurred early on in the pandemic, potentially connected to reductions that were happening before the pandemic related to shifts in finance availability. I certainly support the Department closely monitoring prices and using appropriate tools to protect

US consumers and companies from unsustainable prices and support DOE continuing to follow congressional direction as it relates to LNG export policy.

b. When considering approvals for the construction of new LNG export facilities, what kind of domestic price impact analyses does the Department do before making a national interest determination?

It is my understanding that DOE considers several studies when making a public interest determination for LNG exports and that these studies have concluded that LNG exports have only a small impact on U.S. natural gas prices. However, if confirmed, I would want to fully understand the analysis and assumptions in studies. While the U.S. Energy Information Administration's (EIA) most recent short-term forecast, published in October 2021, shows that U.S. domestic prices are expected to recede in the next few months and production will reach all-time highs in 2022, maintaining domestic affordability and availability of fuels is critical.

Question 2: The 1992 amendments to the Natural Gas Act place the burden on consumers to prove that LNG export terminal approvals to non-free trade agreement countries are in the public interest.

a. Should companies who would financially benefit from exporting have the burden to prove that exports are in the public interest?

It is my understanding that DOE applies the standard set forth explicitly in section 3(a) of the Natural Gas Act (NGA), which requires the Secretary to approve a non-Free Trade Agreement application for export authorization unless she finds that the proposed export will not be consistent with the public interest. It is also my understanding that this has been consistently applied, and that the U.S. Court of Appeals for the District of Columbia Circuit has affirmed this position. If confirmed, I would want to more deeply understand this process to ensure there is adequate public participation and that the DOE fully considers any unique aspects or concerns raised in each proceeding.

Questions from Senator James Lankford

Question 1: Mr. Crabtree, at your confirmation hearing, we discussed the viability and future of carbon capture and storage technology. Could you please provide a per ton cost estimate of this technology that includes the costs to capture, transport, and store carbon?

Costs to capture, transport, and store carbon are highly dependent on context, including the capture technology employed, source of CO2, concentration of CO_2 available for capture, amount of CO2 and distance to be transported, and the type of storage. Capture costs from sectors producing concentrated streams of CO2, such as ethanol production, gas processing and ammonia production, are quite low, but facilities in these industries commonly feature smaller volumes of CO2 and are often located far from existing CO2 transport infrastructure

and geologic storage options. This can lead to higher CO2 transport and storage costs on a per ton basis, even when capture costs are low. Conversely, certain heavy industrial sectors and power generation tend to have higher costs of capture due to typically much lower concentrations of CO2 in flue gas streams. However, facilities in these sectors tend to have larger total volumes of CO2 available for capture, which can create cost-saving economies of scale in CO2 transport and geologic storage.

Thus, to the extent that federal tax credits and other incentives reward emissions reductions achieved by carbon management technologies, some applications of carbon capture and storage and associated CO2 transport infrastructure are already cost-effective on a per ton basis among other essential emissions reduction measures in the broader portfolio of options needed to achieve net-zero emissions economywide. At the same time, other applications of CO2 capture and storage will require additional support from DOE through federal grants, loans and other assistance to complement federal tax credits in closing cost gaps and reducing commercial risk to enable deployment and further bring down costs down over time.

Question 2: Mr. Crabtree, at your confirmation hearing, we briefly discussed carbon dioxide-enhanced oil recovery.

- Do you believe that CO2-EOR would continue to be deployed should the 45Q tax credit be eliminated for EOR?

  CO2-EOR is an established and ongoing commercial activity that has been practiced in the United States since 1972 (well before the existence of the 45Q tax credit), predominantly with the use of natural CO2, which does not qualify for the credit. However, under current law, one of the applications of the federal 45Q tax credit provides an incentive for capturing CO2 from industrial facilities, power plants and ambient air and then storing that CO2 geologically through enhanced oil recovery. Therefore, the elimination of 45Q would have an impact on projected CO2-EOR production relying on captured CO2, as part of integrated carbon capture, transport and storage systems.

- Do you believe that CO2-EOR has place in our carbon management strategy long-term?

  Yes, in certain circumstances. As noted previously, most current CO2-EOR production relies on natural CO2 sourced from geologic domes, which does not provide a carbon management benefit. To the extent that captured CO2 emissions replace natural CO2 now used in EOR operations, the overall carbon footprint of that oil production will be reduced.

Question from Senator Catherine Cortez Masto

Question: As we discussed during the hearing – you have extensive knowledge of Direct Air Capture (DAC), and your written testimony emphasized the need for U.S. leadership to manufacture and export new technologies, like DAC, to tackle climate change.

a. How great of an economic opportunity do negative emission technologies, like DAC, present? And how would you work to build on recent R&D investments – such as those included in the *Energy Act of 2020* (Division Z of P.L. 116-260) – to approach competition with other countries?

The scale of need for negative emission technologies to reach Administration goals of net-zero emissions by 2050 depends on the extent to which emissions to the atmosphere can be avoided, which is the priority. Many of the recent studies (NASEM, IPCC) have indicated the need for gigaton levels of carbon removal by mid-century, which is a significant scale up from what is being practiced today (1000s of tons of removal). Thus, negative emissions technologies represent not just a climate necessity, but also an economic opportunity and potential source of new, high-wage jobs for those countries that establish and maintain technology leadership in this arena. If confirmed, I will continue to focus on direct air capture and other carbon dioxide removal approaches that are being researched and developed in FECM, consistent with the authorizations in the 2020 Energy Act and other congressional direction.

b. In your opinion, what additional growth in the clean energy sector will be needed to support negative emission technologies? Can you please expand on the long-term planning and models that you touched on in your in-person response?

Carbon dioxide removal approaches to negative emissions are diverse. Some require energy inputs, and some do not. Even for direct air capture, the technologies vary with some technologies requiring low qualities of heat and others requiring high heat. Some will require water while others are net producers. The extent of negative emissions need, in addition to the energy requirements for negative emissions, are path dependent. DOE FECM conducts RDD&D on diverse approaches to carbon dioxide removal.

Question from Senator Mark Kelly

Question: If confirmed, you would oversee the Department of Energy Office of Oil and Natural Gas and the Strategic Petroleum Reserves. Arizona gets most of its gasoline by pipeline from refineries in southern California and West Texas. If confirmed, do I have your commitment that any action the Department may take on rising gas prices closely examines how refinery capacity in both those states impacts Arizona?

Yes, if confirmed, I will make sure that policy recommendations include an examination of refinery capacity and its impact on Arizona and all U.S. consumers.