DE-FOA-0002687: Request for Information on Industrial Decarbonization Priorities

DATE: January 27, 2022
SUBJECT: Request for Information (RFI)

Description

The Advanced Manufacturing Office (AMO) is seeking information to better understand industrial priorities for decarbonization, including emerging technologies that could be demonstrated or adopted by the industrial sector. This request for information (RFI) is specifically focused on aspects of industrial decarbonization associated with key industrial sectors, including chemicals, iron and steel, food and beverages, and cement, in addition to other manufacturing industries or crosscutting technology areas that would have a substantial level of emissions reduction in the industrial sector. Information collected in this RFI may also be used by other DOE offices collaborating with AMO, including DOE's newly formed Office of Clean Energy Demonstrations (OCED), for planning purposes including implementation of provisions enacted in the Bipartisan Infrastructure Law (BIL).[1]

Background

AMO is a technology office within the Department of Energy's (DOE) Office of Energy Efficiency & Renewable Energy (EERE). AMO is the only technology development office within the U.S. Government that is dedicated to improving the energy efficiency, material efficiency, productivity, and competitiveness of manufacturers across the industrial sector. The AMO mission is to catalyze research, development, and adoption of energy-related advanced manufacturing technologies and practices to drive U.S. economic competitiveness and energy productivity[2]. To achieve its mission, AMO partners with private and public stakeholders and invests in cost-shared research, development, and demonstration (RD&D) of innovative, next generation manufacturing processes and production technologies that will improve efficiency and reduce emissions, reduce industrial waste and reduce the life-cycle energy consumption of manufactured products.

The scope of Industrial Decarbonization and specific topics of interest follow.

[1] Infrastructure Investment and Jobs Act, Public Law 117-58 (November 15, 2021). Among the relevant provisions enacted, of particular interest is Title X—Authorization of Appropriations for Energy Act of 2020, Section 41008 – Industrial Emissions Demonstration Projects. https://www.congress.gov/bill/117th-congress/house-bill/3684
[2] Advanced Manufacturing Office Mission and Goals, U.S. Department of Energy, 2020. https://www.energy.gov/eere/amo/vision-mission-and-goals

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To avoid overshooting 1.5 degrees Celsius of global temperature rise, the United States is targeting "net-zero emissions, economy-wide, by no later than 2050"[3]. Industry accounts for almost one-third of the nation's primary energy use and nearly 30% of energy-related Greenhouse Gas (GHG) emission[4], with refining, chemicals, iron and steel, food products, and cement representing the GHG emitting sectors. This level of energy consumption and GHG emissions represents a need for clean and efficient manufacturing technologies and; therefore, an opportunity for innovation. A significant portion of the U.S. industrial sector is considered "difficult-to-decarbonize", due in part to the diversity of energy inputs into a wide array of heterogeneous industrial processes and operations. Technology development, demonstration, and deployment that enable emissions reduction in the industrial sector will be critical to achieving the goal of net zero emissions by 2050.

The achievement of a low-carbon industrial sector in the United States poses a range of structural and technical challenges. The sheer multitude of materials transformations – from extraction to intermediate and final products – will require a wide range of technology solutions that will have a ripple effect across a variety of industries and their increasingly complex supply chains. Further, anticipated industrial product demand growth of over 30% by 2050 with an associated increase in GHG emissions exceeding 15%[5] will only increase the difficulty. Despite these challenges to industrial decarbonization, the industrial sector can improve manufacturing productivity, develop innovative products, increase global competitiveness and meet expanding societal needs for jobs and product accessibility while reducing its carbon dependence (i.e., decarbonizing) and providing community benefits. Because industrial decarbonization could take decades, it is imperative to start now to minimize the cumulative effects of GHG emissions and to catalyze the knowledge needed to implement the transition and meet the 2050 goals.

Due to the abovementioned complexity and urgency for industrial decarbonization, there are many approaches that must be pursued simultaneously. These approaches include: energy efficiency (EE); electrification and low-carbon fuels, feedstocks and energy sources (LCFFES); and carbon capture, utilization & storage (CCUS). As seen in Figure 1, all approaches are expected to provide significant contributions to overall emissions reduction in the industrial sub-sector. Although future emissions benefits from each approach could potentially be roughly equivalent by 2050, the state of technology today varies quite a bit and depends not only on

[3] Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad," January 27, 2021. https://www.federalregister.gov/documents/2021/02/01/2021-02177/tackling-the-climate-crisis-at-home-and-abroad

[4] Exact percentages can vary from year to year based on weather and economic factors; in particular 2020 may not be representative due to impacts from the COVID pandemic. For additional information: Energy Use in Industry. U.S. Energy Information Administration. 2021. https://www.eia.gov/energyexplained/use-of-energy/industry.php; including feedstocks – fossil inputs into materials (chemicals and plastics).

[5] United States Energy Information Administration, Annual Energy Outlook 2021 with Projections to 2050. https://www.eia.gov/outlooks/aeo/

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the approach but also on the sector to which it is applied. AMO aims to prioritize industrial decarbonization strategies that are within the scope of its mission and have the largest impact.

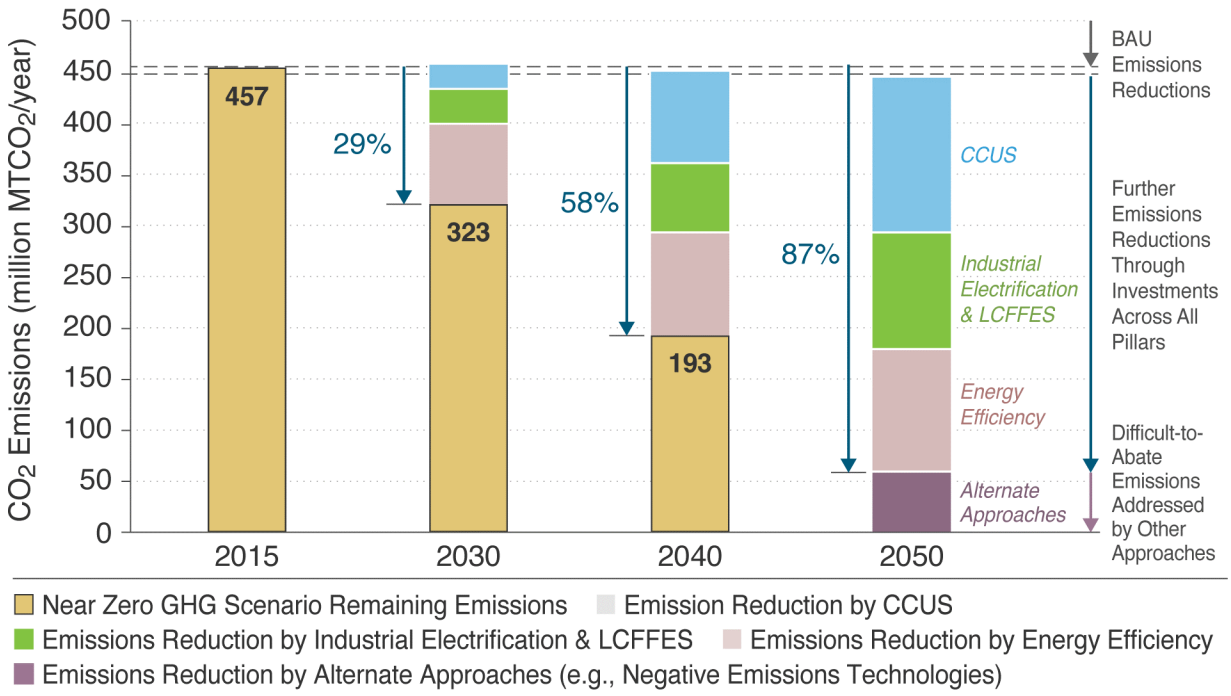

Figure 1: CO_2 emissions (million MT/year) reduction potential across the decarbonization pillars (EE, electrification & LCFFES, and CCUS) for key segments of the U.S. iron and steel, chemical manufacturing, food manufacturing, refining, and cement sectors to achieve zero GHG emissions. The "Alternate Approaches" band shows further emissions reductions from approaches not specifically evaluated in scenario modeling, including negative-emissions technologies. Source: AMO Industrial Decarbonization Roadmap, currently under review.

The variety in technology needs across various industrial sub-sectors adds another layer of complexity to emissions abatement. The five highest GHG emitting industrial sub-sectors are: iron and steel, chemicals, food and beverage, petroleum refining, and cement. Figure 2 shows their contributions to the overall energy-related emissions in the industrial sector, which collectively account for roughly 62% of manufacturing-related emissions (including associated electricity generation and transmission losses). Process emissions also constitute a considerable portion of GHG emissions in certain industries (e.g., cement, chemicals).

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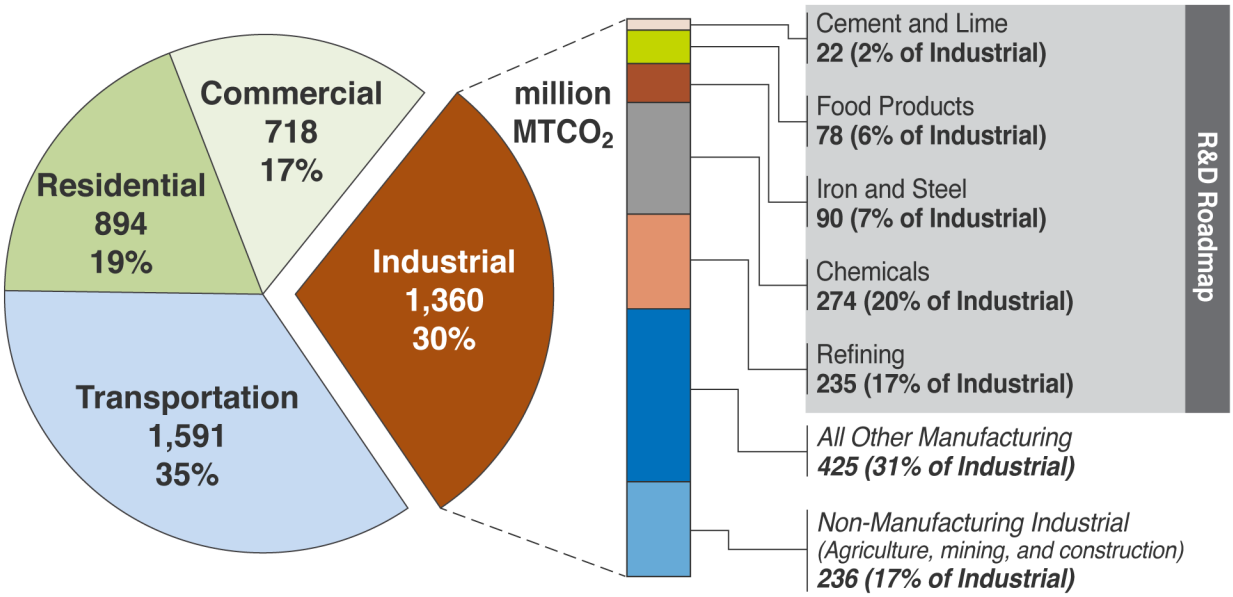

Figure 2: U.S. primary energy-related CO_2 emissions by economic sector (left pie chart) and a breakout by industrial subsector (right stacked chart) in 2020. Electricity losses allocated to end-use sectors. The CO_2 emission in million metric tons ($MTCO_2$) is shown, as well as the percent contribution of that sector of the whole. Data source: EIA 2021[6]

Although some technology needs will be sector-specific, there are other cross-cutting technology improvements that could reduce emissions across multiple sub-sectors. Industrial heating, for example, makes up a significant fraction of the energy consumed by the industrial sector. Traditional fuel-fired industrial (thermal) processes can be inefficient, difficult to control and result in materials and products with compromised quality and performance. Since the heat that drives these processes is overwhelmingly driven by fossil fuels today, industrial heating is also a significant contributor to emissions.

Due to the complexity of industrial decarbonization, many methods must be pursued in parallel and multiple technology options are needed to fit the needs of a diverse industrial sector. The goal of this RFI is to solicit feedback on what approaches, sub-sectors, cross-cutting challenges, or other focus areas are best suited to accelerate the development, demonstration, and adoption of GHG-reducing technologies within the industrial sector.

[6] 2020 data includes impacts from the COVID pandemic. United States Energy Information Administration, Annual Energy Outlook 2021 with Projections to 2050. https://www.eia.gov/outlooks/aeo/

Purpose

The purpose of this RFI is to solicit feedback from industry, academia, research laboratories, government agencies, and other stakeholders on issues related to research, development, demonstration, and deployment of technologies to address the technical challenges related to emissions reduction and decarbonization of the U.S. industrial sector. EERE is specifically interested in information on aspects of industrial decarbonization associated with key industrial sectors, including chemicals, iron and steel, food and beverages, and cement, in addition to other manufacturing industries or crosscutting technology areas that would have a substantial level of emissions reduction in the industrial sector. This is solely a request for information and not a Funding Opportunity Announcement (FOA). EERE is not accepting applications.

Disclaimer and Important Notes

This RFI is not a Funding Opportunity Announcement (FOA); therefore, EERE is not accepting applications at this time. EERE may issue a FOA in the future based on or related to the content and responses to this RFI; however, EERE 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 EERE chooses to issue a FOA regarding the subject matter. Final details, including the anticipated award size, quantity, and timing of EERE funded awards, will be subject to Congressional appropriations and direction.

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; this RFI does not constitute a formal solicitation for proposals or abstracts. Your response to this notice will be treated as information only. EERE 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. EERE will not provide reimbursement for costs incurred in responding to this RFI. Respondents are advised that EERE 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 EERE to any further actions related to this topic.

Confidential Business Information

Pursuant to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email, postal mail, or hand delivery two well-marked copies: one copy of the document marked "confidential" including all the information believed to be confidential, and one copy of the document marked "non-confidential" with the information believed to be confidential deleted. Submit these

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documents via email or on a CD, if feasible. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

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 EERE 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.

Request for Information Categories and Questions

Category 1 Chemical Industry Decarbonization

The chemical industry is the largest energy user in the U.S. industrial sector and accounted for an estimated 274 million metric tons of energy-related CO_2 emissions in 2020. AMO is interested in RD&D needed to accelerate the commercial readiness of emerging, net-zero carbon, process technologies for the chemical industry, as well as related workforce and community needs. Considering the key pillars of industrial decarbonization – industrial electrification, energy efficiency, low carbon fuels, feedstocks, and energy sources, and carbon capture utilization and storage – AMO is soliciting industry feedback to identify the greatest opportunities to reduce energy consumption and emissions through impactful RD&D opportunities and enable an accelerated timeline for achieving GHG emission reductions in, and across the supply chain of the chemical industry.

C1.1 What emerging decarbonization technologies could have the most impact in the chemical industry over the next 5-10 years, and 10-20 years? Which of these technologies are applicable to the production of:

- Basic organic chemicals.
- Petrochemicals.
- Ethanol and bio-based chemicals.
- Plastic and resin materials.
- Inorganic chemicals and industrial gases.
- Other chemicals.

C1.2 What primary factors are driving decisions on demonstrations of new technologies that reduce GHG emissions? Which promising technologies are most appropriate for

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demonstrating in the U.S. marketplace? Which technologies are ready for pilot plant scale-up, and which are ready for commercial demonstration?

C1.3 What is the magnitude (e.g., output rate and cost) of potential pilot or demonstration scale projects that could be undertaken in the next five years? What are the most critical performance characteristics (e.g., efficiency, GHG emissions, capital or operating costs, product quality) these projects need to demonstrate?

C1.4 What limiting factors or challenges does the chemical industry face in broadly deploying decarbonization technologies in the United States?

C1.5 What DOE resources would most benefit the U.S. chemical industry to accelerate decarbonization? For example:

- RD&D options could include federal funding to support research and development projects, technology testbeds, pilot-scale demonstrations, and larger, commercial-scale demonstrations. The federal funding would be subject to a cost share requirement.
- Technical assistance options could include emerging technology validation, deployment assistance for new energy- and carbon-saving technologies, energy/carbon assessments, analysis tools, and workforce training.
- Financial options could include the DOE Loan Program (access to capital, flexible financing).

C1.6 How can technologies leading toward decarbonization of the chemical industry be commercialized and deployed with positive impacts to the surrounding community?

C1.7 What DOE resources or actions could support improvement of areas surrounding chemical industry facilities, particularly for disadvantaged communities in the transition to a decarbonized energy economy?

C1.8 Provide any additional information relevant to the energy efficiency and GHG reduction opportunities/challenges of the chemical industry that do not fit into the previous questions in this Category. This could include various industry data, references, or technical information.

Category 2 Iron and Steel Industry Decarbonization

The U.S. steel industry produced about 73 million metric tons of crude steel in 2020, and accounted for an estimated 90 million metric tons of energy-related CO_2 emissions in the same year. AMO is interested in RD&D needed to accelerate the commercial readiness of emerging, net-zero carbon, process technologies for the steel industry, as well as related workforce and community needs. Considering the key pillars of industrial decarbonization – industrial electrification, energy efficiency, low carbon fuels, feedstocks, and energy sources, and carbon capture utilization and storage – AMO is soliciting industry feedback to identify the greatest opportunities to reduce energy consumption and emissions through impactful RD&D

opportunities and enable an accelerated timeline for achieving GHG emission reductions in the steel industry.

C2.1 What emerging decarbonization technologies could have the most impact in the steel industry over the next 5-10 years, and 10-20 years? Which of these technologies are applicable to:
- Integrated steelmaking (blast furnace/basic oxygen furnace) operations.
- Electric arc furnace steelmaking operations.
- Direct reduced iron operations.
- Downstream steel mill operations (e.g., reheat furnaces and finishing operations).
- Other operations or opportunities.

C2.2 What primary factors are driving decisions on demonstrations of new technologies that reduce GHG emissions? Which promising technologies are most appropriate for demonstrating in the U.S. marketplace? Which technologies are ready for pilot plant scale-up, and which are ready for commercial demonstration?

C2.3 What is the magnitude (e.g., output rate and cost) of potential pilot or demonstration scale projects that could be undertaken in the next five years? What are the most critical performance characteristics (e.g., efficiency, GHG emissions, capital or operating costs, product quality) these projects need to demonstrate?

C2.4 What limiting factors or challenges does the steel industry face in broadly deploying decarbonization technologies in the United States?

C2.5 What DOE resources would most benefit the U.S. steel industry to accelerate decarbonization? For example:
- RD&D options could include federal funding to support research and development projects, technology testbeds, pilot-scale demonstrations, and larger, commercial-scale demonstrations. The federal funding would be subject to a cost share requirement.
- Technical assistance options could include emerging technology validation, deployment assistance for new energy- and carbon-saving technologies, energy/carbon assessments, analysis tools, and workforce training.
- Financial options could include the DOE Loan Program (access to capital, flexible financing).

C2.6 How can technologies leading toward decarbonization of the iron and steel industry be commercialized and deployed with positive impacts to the surrounding community?

C2.7 What DOE resources or actions could support improvement of areas surrounding iron and steel industry facilities, particularly for disadvantaged communities in the transition to a decarbonized energy economy?

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C2.8 Provide any additional information relevant to the energy efficiency and GHG reduction opportunities/challenges of the steel industry that do not fit into the previous questions in this Category. This could include various industry data, references, or technical information.

Category 3 Food and Beverage Industry Decarbonization

The food and beverage industry is a critical component of the U.S. economy, employing approximately 1.7 million workers. It accounted for an estimated 78 million metric tons of energy-related CO_2 emissions in 2020. AMO is interested in RD&D needed to accelerate the commercial readiness of emerging, net-zero carbon, process technologies for the food and beverage industry, as well as related workforce and community needs. Considering the key pillars of industrial decarbonization – industrial electrification, energy efficiency, low carbon fuels, feedstocks, and energy sources, and carbon capture utilization and storage – AMO is soliciting industry feedback to identify the greatest opportunities to reduce energy consumption and emissions through impactful RD&D opportunities and enable an accelerated timeline for achieving GHG emission reductions in the food and beverage industry, along with opportunities for controlled environment agriculture.

C3.1 What emerging decarbonization technologies could have the most impact in the food and beverage industry over the next 5-10 years, and 10-20 years? Which of these technologies are applicable to:

- Grain and oilseed milling operations.
- Animal slaughtering and processing operations.
- Fruit and vegetable processing operations.
- Dairy product operations.
- Sugar manufacturing operations.
- Beverage manufacturing operations.
- Bakery operations.
- Other food processing operations.

C3.2 What primary factors are driving decisions on demonstrations of new technologies that reduce GHG emissions? Which promising technologies are most appropriate for demonstrating in the U.S. marketplace? Which technologies are ready for pilot plant scale-up, and which are ready for commercial demonstration?

C3.3 What is the magnitude (e.g., output rate and cost) of potential pilot or demonstration scale projects that could be undertaken in the next five years? What are the most critical performance characteristics (e.g., efficiency, GHG emissions, capital or operating costs, product quality) these projects need to demonstrate?

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C3.4 What limiting factors or challenges does the food and beverage industry face in broadly deploying decarbonization technologies in the United States?

C3.5 What DOE resources would most benefit the U.S. food and beverage industry to accelerate decarbonization? For example:

- RD&D options could include federal funding to support research and development projects, technology testbeds, pilot-scale demonstrations, and larger, commercial-scale demonstrations. The federal funding would be subject to a cost share requirement.
- Technical assistance options could include emerging technology validation, deployment assistance for new energy- and carbon-saving technologies, energy/carbon assessments, analysis tools, and workforce training.
- Financial options could include the DOE Loan Program (access to capital, flexible financing).

C3.6 How can technologies leading toward decarbonization of the food and beverage industry be commercialized and deployed with positive impacts to the surrounding community?

C3.7 What DOE resources or actions could support improvement of areas surrounding food and beverage industry facilities, particularly for disadvantaged communities in the transition to a decarbonized energy economy?

C3.8 What are the barriers to the development and deployment of Controlled Environment Agriculture (CEA), an advanced and intensive approach to food production using high-tech indoor farming through controlling the variables (lighting, water, CO_2, nutrients, etc.) which affect plant growth?

C3.9 What CEA technologies and strategies pose the largest potential for reduced emissions and can they be integrated to realize that potential? How will advanced technologies that enable CEA differ depending on the scale of operation and regional characteristics?

C3.10 Provide any additional information relevant to the energy efficiency and GHG reduction opportunities/challenges of the food and beverage industry that do not fit into the previous questions in this Category. This could include various industry data, references, or technical information.

Category 4 Cement and Concrete Industry Decarbonization

The U.S. cement industry produced nearly 90 million metric tons of cement in 2020, and accounted for about 22 million metric tons of energy-related CO_2 emissions in addition to approximately 40 million metric tons of process CO_2 emissions. AMO is interested in RD&D needed to accelerate the commercial readiness of emerging, net-zero carbon, process technologies for the cement and concrete industry, as well as related workforce and community needs. Considering the key pillars of industrial decarbonization – industrial electrification, energy efficiency, low carbon fuels, feedstocks, and energy sources, and carbon capture utilization and storage – AMO is soliciting industry feedback to identify the greatest

opportunities to reduce energy consumption and emissions through impactful RD&D opportunities and enable an accelerated timeline for achieving GHG emission reductions in the cement and concrete industry.

C4.1 What emerging decarbonization technologies could have the most impact in the cement and concrete industry over the next 5-10 years, and 10-20 years? Which of these technologies are applicable to:
- Portland cement kiln operations.
- Grinding and other mechanical operations.
- Supplementary cement materials.
- Novel chemistries and components.
- Other opportunities.

C4.2 What primary factors are driving decisions on demonstrations of new technologies that reduce GHG emissions? Which promising technologies are most appropriate for demonstrating in the U.S. marketplace? Which technologies are ready for pilot plant scale-up, and which are ready for commercial demonstration?

C4.3 What is the magnitude (e.g., output rate and cost) of potential pilot or demonstration scale projects that could be undertaken in the next five years? What are the most critical performance characteristics (e.g., efficiency, GHG emissions, capital or operating costs, product quality) these projects need to demonstrate?

C4.4 What limiting factors or challenges does the cement and concrete industry face in broadly deploying decarbonization technologies in the United States?

C4.5 What DOE resources would most benefit the U.S. cement and concrete industry to accelerate decarbonization? For example:
- RD&D options federal funding to support research and development projects, technology testbeds, pilot-scale demonstrations, and larger, commercial-scale demonstrations. The federal funding would be subject to a cost share requirement.
- Technical assistance options could include emerging technology validation, deployment assistance for new energy- and carbon-saving technologies, energy/carbon assessments, analysis tools, and workforce training.
- Financial options could include the DOE Loan Program (access to capital, flexible financing).

C4.6 How can technologies leading toward decarbonization of the cement and concrete industry be commercialized and deployed with positive impacts to the surrounding community?

C4.7 What DOE resources or actions could support improvement of areas surrounding cement and concrete industry facilities, particularly for disadvantaged communities in the transition to a decarbonized energy economy?

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C4.8 Provide any additional information relevant to the energy efficiency and GHG reduction opportunities/challenges of the cement and concrete industry that do not fit into the previous questions in this Category. This could include various industry data, references, or technical information.

Category 5 Significant Decarbonization Opportunities in Other Manufacturing Industries

The objective of this category is to solicit information on other manufacturing industries (e.g., pulp and paper, wood products, aluminum) that would have a substantial level of industrial emissions reduction opportunity in their production operations. AMO is interested in RD&D needed to accelerate the commercial readiness of emerging, net-zero carbon, process technologies. Considering the key pillars of industrial decarbonization – industrial electrification, energy efficiency, low carbon fuels, feedstocks, and energy sources, and carbon capture utilization and storage – AMO is soliciting industry feedback to identify the greatest opportunities to reduce energy consumption and emissions through impactful RD&D opportunities and enable an accelerated timeline for achieving GHG emission reductions in other manufacturing industries, as well as related workforce and community needs.

C5.1 What emerging decarbonization technologies could have the most impact in other manufacturing industries over the next 5-10 years, and 10-20 years?

C5.2 What primary factors are driving decisions on demonstrations of new technologies that reduce GHG emissions? Which promising technologies are most appropriate for demonstrating in the U.S. marketplace? Which technologies are ready for pilot plant scale-up, and which are ready for commercial demonstration?

C5.3 What is the magnitude (e.g., output rate and cost) of potential pilot or demonstration scale projects that could be undertaken in the next five years? What are the most critical performance characteristics (e.g., efficiency, GHG emissions, capital or operating costs, product quality) these projects need to demonstrate?

C5.4 What limiting factors or challenges do these manufacturing industries face in broadly deploying decarbonization technologies in the United States?

C5.5 What DOE resources would be most beneficial to accelerate decarbonization? For example:

- RD&D options could include federal funding to support research and development projects, technology testbeds, pilot-scale demonstrations, and larger, commercial-scale demonstrations. The federal funding would be subject to a cost share requirement.
- Technical assistance options could include emerging technology validation, deployment assistance for new energy- and carbon-saving technologies, energy/carbon assessments, analysis tools, and workforce training.

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- Financial options could include the DOE Loan Program (access to capital, flexible financing).

C5.6 How can technologies leading toward decarbonization of other manufacturing industries be commercialized and deployed with positive impacts to the surrounding community?

C5.7 What DOE resources or actions could support improvement of areas surrounding other manufacturing facilities, particularly for disadvantaged communities in the transition to a decarbonized energy economy?

C5.8 Provide any additional information relevant to the energy efficiency and GHG reduction opportunities/challenges in other manufacturing industries within the industrial sector that do not fit into the previous questions in this Category. This could include various industry data, references, or technical information.

Category 6 Crosscutting Industrial Decarbonization Opportunities

The objective of this category is to solicit information on crosscutting technology areas, such as steam systems and process heating, that would have a substantial level of industrial emissions reduction opportunity. AMO is interested in RD&D needed to accelerate the commercial readiness of emerging, net-zero carbon, process technologies. Considering the key pillars of industrial decarbonization – industrial electrification, energy efficiency, low carbon fuels, feedstocks, and energy sources, and carbon capture utilization and storage – AMO is soliciting industry feedback to identify the greatest opportunities to reduce energy consumption and emissions through impactful RD&D opportunities and enable an accelerated timeline for achieving GHG emission reductions in crosscutting technology areas within the industrial sector.

C6.1 What emerging decarbonization technologies could have the most impact in the industrial sector over the next 5-10 years, and 10-20 years?

C6.2 What primary factors are driving decisions on demonstrations of new technologies that reduce GHG emissions? Which promising technologies are most appropriate for demonstrating in the U.S. marketplace? Which technologies are ready for pilot plant scale-up, and which are ready for commercial demonstration?

C6.3 What is the magnitude (e.g., output rate and cost) of potential pilot or demonstration scale projects that could be undertaken in the next five years? What are the most critical performance characteristics (e.g., efficiency, GHG emissions, capital or operating costs, product quality) these projects need to demonstrate?

C6.4 What limiting factors or challenges do these crosscutting technology areas face regarding broad deployment in the United States?

C6.5 What DOE resources would be most beneficial to accelerate decarbonization? For example:

- RD&D options could include federal funding to support research and development projects, technology testbeds, pilot-scale demonstrations, and larger, commercial-scale demonstrations. The federal funding would be subject to a cost share requirement.
- Technical assistance options could include emerging technology validation, deployment assistance for new energy- and carbon-saving technologies, energy/carbon assessments, analysis tools, and workforce training.
- Financial options could include the DOE Loan Program (access to capital, flexible financing).

C6.6 Provide any additional information relevant to the energy efficiency and GHG reduction opportunities/challenges in crosscutting technology areas within the industrial sector that do not fit into the previous questions in this Category. This could include various industry data, references, or technical information.

Category 7 Specific Industrial Decarbonization Challenges

The objective of this category is to solicit additional information on specific challenges associated with the decarbonization of the industrial sector. Responses should focus primarily on technical topics but also include economic and social aspects when applicable.

C7.1 What are the challenges unique to small and medium-sized manufacturers?

C7.2 What are the challenges unique to specific geographic regions of the United States?

C7.3 What are the challenges related to utilizing onsite carbon-free power generation (e.g., solar, wind) in industrial applications?

C7.4 What are the challenges in retaining or reclaiming a domestic competitive advantage in energy-intensive, trade-exposed industries as GHG emissions in those industries are reduced?

C7.5 What are the challenges related to key unit operations equipment and supply chain gaps that need to be addressed to enable decarbonization?

C7.6 What are the challenges and opportunities to support and grow market demand for low-carbon, U.S. made industrial products? Would the collection, tracking, and reporting of transparent data on GHG intensity and embodied carbon of industrial products be supportive?

C7.7 How can DOE most effectively and transformatively support industrial decarbonization? For example, supporting facilities to reduce emissions through efficiency improvements versus demonstrations of "best-in-class" facilities that accelerate the development and commercialization of zero emission industrial processes. What are the trade-offs between the various approaches?

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C7.8 Provide any additional information relevant to specific decarbonization challenges of the industrial sector that do not fit into the previous questions in this Category. This could include various industry data, references, or technical information.

Category 8 Industrial Decarbonization Workforce, Community, and Equity Considerations

It is critical that industrial decarbonization strategies: a) create opportunities for skilled job training and quality, long-term employment; and b) incorporate measures to advance equity for all, including disadvantaged communities who have been historically marginalized and overburdened by pollution and underinvestment in housing, transportation, water and wastewater infrastructure, and health care. In addition to these first two considerations, DOE is committed to the Justice40 Initiative,[7] which states that 40% of the overall benefits of certain federal investments will flow to disadvantaged communities ,[8] and that projects will have minimal negative impacts on communities with environmental justice concerns.

To ensure DOE's investments best incorporates these considerations, this category is intended to solicit additional information on workforce, equity, and community impacts associated with the decarbonization of the industrial sector.

C8.1 In what ways, if any, do you anticipate decarbonization processes could impact your workforce?

C8.2 What are the challenges in developing and retaining a skilled, diverse workforce to achieve industrial decarbonization? How should DOE best engage and partner with the skilled workforce to pioneer new approaches? How can industrial decarbonization support improved job quality and provide a competitive advantage?

C8.3 What community considerations should DOE incorporate into future decarbonization investments? What are the local dependencies that are instrumental to success, and will DOE need to evaluate these dependencies to ensure investments are high-impact?

C8.4 As the industrial sector decarbonizes, what are the challenges in delivering equitable outcomes? What DOE resources or actions could support improvement of areas surrounding industrial facilities, particularly disadvantaged communities that have been historically marginalized and overburdened by pollution and underinvestment in housing, transportation, water and wastewater infrastructure, and health care?

C8.5 What equity, environmental and energy justice concerns or priorities are most relevant to future decarbonization investments?

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[7] The Justice40 initiative, established by E.O. 14008, states that 40% of the overall benefits of certain federal investments should flow to disadvantaged communities.

[8] The Justice40 Interim Guidance provides a broad definition of DACs (Page 2): https://www.whitehouse.gov/wp-content/uploads/2021/07/M-21-28.pdf

C8.6 What measures should be incorporated into decarbonization efforts to ensure that harm to disadvantaged communitiesare mitigated?

C8.7 Provide any additional information relevant to workforce, community, and equity considerations that do not fit into the previous questions in this category. This could include various industry data, references, or technical information.

Category 9 Iron, Steel, Manufactured Products, or Construction Materials

DOE is collecting the following information to help inform the implementation of the Buy American Preference requirements set forth in section 70914 of the Bipartisan Infrastructure Law.

C9.1 Do you anticipate applying for DOE financial assistance funding (e.g., grants, cooperative agreements) for projects that involve the construction, alteration, maintenance, or repair of any of the following:

a. Roads, highways, and bridges;
b. Public transportation;
c. Dams, ports, harbors, and other maritime facilities;
d. Intercity passenger and freight railroads;
e. Airports;
f. Water systems, including drinking water and wastewater systems;
g. Electrical transmission facilities and systems;
h. Utilities;
i. Broadband infrastructure; and
j. Buildings and real property.

C9.2 If your response to question C9.1 is yes, will this work require any iron or steel?

a. If yes, in the absence of any requirement to do so, would you seek to procure these goods domestically?
    i. If your answer to C9.2a is no, what circumstances are present that lead you to this response? For example, is it due to scarcity of these products domestically, or cost?

C9.3 If your response to question C9.1 is yes, will this work require any manufactured products?

a. If yes, in the absence of any requirement to do so would you seek to procure these goods domestically?
    i. If your answer to C9.3a is no, what circumstances are present that lead you to this response? For example, is it due to scarcity of these manufactured goods domestically, or cost?

C9.4 If your response to question C9.1 is yes, will this work require any construction materials?

a. If yes, in the absence of any requirement to do so, would you seek to procure these goods domestically?
    i. If your answer to C9.4a is no, what circumstances are present that led you to this response? For example, is it due to a lack of availability of these manufactured goods domestically, or cost?

C9.5 Please identify any manufactured goods which are crucial to work in your industry focused on infrastructure which you would not typically seek to procure domestically. For each, please specify to the best of your ability whether you would avoid seeking to procure these items domestically due to scarcity or cost.

Request for Information Response Guidelines

Responses to this RFI must be submitted electronically to Industrial-Decarb-RFI@ee.doe.gov no later than 5:00 pm (ET) on February 28, 2022. 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 Microsoft Word (.docx) attachment to the email, and no more than 9 pages in length, 12 point font, 1 inch margins. Only electronic responses will be accepted, and respondents are encouraged to include their organization name at the beginning of their attachment filename.

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.

EERE 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.

This is a Request for Information (RFI) only. EERE will not pay for information provided under this RFI and no project will be supported as a result of this RFI. This RFI is not accepting applications for financial assistance or financial incentives. EERE may or may not issue a Funding Opportunity Announcement (FOA) based on consideration of the input received from this RFI.