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MEMORANDUM

To: Julie Lockwood and Marjorie Kaplan, Rutgers Climate and Energy Institute

From: Lewis-Burke Associates, LLC

Date: March 26, 2024

Re: Federal Funding Landscape on the Bioeconomy

Executive Summary

In September 2022, the Biden Administration took its most significant steps to date towards advancing the U.S. bioeconomy by announcing a new Executive Order (EO) and holding an accompanying White House summit to launch a new National Biotechnology and Biomanufacturing Initiative (NBBI). Through these efforts, the White House emphasized that biotechnology and biomanufacturing have the potential to make a significant positive impact on public health, climate change, national security, energy, agriculture, and supply chain resilience, among other areas. The NBBI aims to unite federal departments and agencies in strengthening investments in research and development in key areas of biotechnology, as well as increase domestic biomanufacturing production capacity at all scales. The Initiative emphasizes the need for improved biological data sharing, regulatory frameworks, and evaluation metrics, as well as the importance of training and supporting a diverse, skilled workforce to advance the bioeconomy. Notably, the EO has served as the guide for many federal agencies, however it did not provide any new funding for this topic, therefore, the initiatives supporting the bioeconomy are somewhat disaggregated and often embedded in existing annual opportunities.

Earlier this year, the National Science Foundation (NSF) has put out a Call to Action to the research community for input on the next stage of advancing the bioeconomy as part of their Catalyzing Across Sectors to Advance the Bioeconomy (CASA-Bio) initiative. CASA-Bio is the latest federal effort to organize activities across agencies related to biotechnology, synthetic biology, and the bioeconomy, and follows from the bioeconomy-focused September 2022 Executive Order and the March 2023 Bold Goals report. CASA-Bio aims to provide direction to the federal government (including research funding agencies) on which specific priorities within the broad bioeconomy landscape are most pressing and ripe for cross-sector collaboration. Slides from an informational webinar about CASA-Bio are available here.

CASA-Bio hosted a series of town halls in February as an opportunity for stakeholders to provide their perspectives on the most important challenges in this space, organized around a series of Subtheme Challenges which are mapped to the priorities of the EO, including Climate Change Solutions, Food and Agriculture Innovation, Supply Chain Resilience, Human Health, and Cross Cutting Advances. NSF viewed these town halls as an information collection and synthesis tool, and no funding opportunities are expected to be released as a direct result of CASA-Bio unless dedicated funding is subsequently provided by Congress.

The following section highlights programs across the federal government that are expected to be competed this Fall in areas pertaining to Climate Solutions and Sustainable Fuels – areas that have been emphasized through the Biden Administration's Bold Goals for U.S. Biotechnology and Biomanufacturing report released in March 2023.

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Climate

The Biden Administration has set the goal of achieving net-zero greenhouse gas (GHG) emissions by 2050 which will necessitate major advances across many economic sectors and investments in technology to enable it. Federal agencies have been tasked with developing programs that support this transformational goal, with specific emphasis on translational activities in bioscience and biotechnology to expedite broad scale implementation to mitigate the effects of climate change. This section aims to outline some of the programs anticipated at the federal level to reduce GHG emissions, develop a greater understanding of biological impacts to the environment, and develop innovative approaches to conservation.

National Science Foundation

- **Building Synthetic Microbial Communities for Biology, Mitigating Climate Change, Sustainability and Biotechnology (Synthetic Communities)** is a biannual program that supports applications that showcase extensive research on synthetic microbial communities. Applicants must center their applications around one or more of three themes provided in the solicitation: "1. define the underlying mechanisms or rules that drive the formation, maintenance or evolution of synthetic microbial communities; 2. use synthetic microbial communities to address fundamental biological questions, including questions in molecular biology, cellular/organismal biology, ecology and evolution; 3. build synthetic communities with biotechnology, bioeconomy or environmental engineering applications, including but not limited to the production of novel biorenewable chemicals, biodegradation of recalcitrant or "forever chemicals," enabling a circular bioeconomy, fostering sustainable agriculture, and mitigating the impacts of climate change. NSF anticipates funding 7-12 awards.
    - Applications are due **August 1, 2024**.
- **Biology Integration Institutes (BII)** program supports applications from collaborative teams that explore research, education, and training across multiple disciplines within and beyond biology. Specifically, the program aims to "bring researchers together around the common goal of understanding how the processes that sustain life and enable biological innovation operate and interact within and across different scales of organization, from molecules to cells, tissues to organisms, species, ecosystems, biomes and the entire Earth. Total program funding is $10 million, NSF anticipates funding 4-5 awards.
    - Applications are due **February 18, 2025**.
- **Biodiversity on a Changing Planet (BoCP)** is an annual program that supports design and implementation proposals that integrate "cellular, organismal, ecological, evolutionary, geological or paleontological approaches" to research the implications of environmental change

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on functional biodiversity. Total program funding is anticipated around $14-17 million. NSF anticipates funding four to six awards.
    - Applications are due **September 5, 2024**.
- **Partnership to Advance Conservation Science and Practice (PACSCP)** is jointly supported annual program from NSF and the Paul G. Allen Family Foundation that supports academic-conservation organization partnerships with the capacity to conduct relevant research on "organismal biology, ecology and evolution to develop and implement action plans and technologies that advance biodiversity conservation." Total program funding is anticipated to be $16 million, with 8-16 awards expected to be funded.
    - Applications for FY 2024 are due **April 24, 2024**, and **December 19, 2024**.

Department of Energy

- **Environmental System Science (ESS)**, within DOE's Office of Science's Biological and Environmental Research (BER) program, the Environmental System Science (ESS) program solicits applications that utilize "measurements, experiments, field data, modeling, and synthesis to provide improved understanding and representation of ecosystems and watersheds in ways that advance the sophistication and capabilities of models that span from individual processes to Earth-system scales." Furthermore, the ESS program seeks to "advance an integrated, robust, and scale-aware predictive understanding of terrestrial systems and their interdependent microbial, biogeochemical, ecological, hydrological, and physical processes." Total program funding for the most recently competed solicitation was $8 million.
    - Pre-applications (required) for the next solicitation are projected to be due **November 30, 2024 and is competed annually**.
- **Regional Energy-Water Demonstration Facilities**, expected in Fall 2024 contingent final FY 2024 appropriations, up to $50 million. DOE proposed launching one or more facilities focused on translating recent R&D outcomes – from hydroclimate prediction to novel desalination and treatment technologies to integrated systems management – to demonstrate and scale water management solutions according to the needs of a specific region. A regional facility would develop new business models for solving water challenges that incorporates stakeholders like local utilities and regulators, industries, and communities in the earliest phase of system design. The demonstration facilities would also provide multi-stakeholder partnership environments to de-risk and test technologies for pre-commercial demonstrations at scale and reduce costs for local utilities and governments.

U.S. Department of Agriculture

- **Agriculture and Food Research Initiative (AFRI)** is USDA's signature extramural research program, and supports a broad range of research projects through three annual solicitations:
        - Sustainable and Agricultural Systems (SAS);
        - Foundational and Applied Science (FAS); and
        - Education and Workforce Development (EWD).
    - These programs also explicitly mentioned an interest in receiving proposals concerning sustainable aviation fuels within the program's overall goal to strengthen the bioeconomy through sustainable bioenergy and biobased products.
- **Biotechnology Risk Assessment Research Grants (BRAG)** program aims "to support the generation of new information that will assist Federal regulatory agencies make science-based decisions about the effects of introducing genetically engineered organisms (GE) into the environment."
    - The 2024 solicitation is anticipated in **November 2024**.

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Sustainable Fuels/Biofuels

The Biden Administration has made investments in Sustainable Aviation Fuels (SAF) a central pillar of its net-zero emissions by 2050 strategy. Investments in SAF, especially in research and development (R&D), are projected to grow in the next several years.

One of five priority areas in the Biden Administration's Net-Zero Game Changers Initiative driving future federal investments is net-zero aviation, including SAF. To better coordinate across federal agencies, the White House launched the Sustainable Aviation Fuels Grand Challenge, led by the Department of Energy but in coordination with over a dozen federal agencies. The goal is to advance research, development, and demonstration activities to supply at least three billion gallons of SAF per year by 2030 (from less than one billion today), and, by 2050, sufficient SAF to meet 100 percent of aviation fuel demands, which is currently projected to be around 35 billion gallons per year. The federal agencies also published a SAF Grand Challenge Roadmap that highlights research, development, and demonstration priorities in six topics areas, such as feedstock production and conversion technologies, focused on expanding SAF supply and end use, reducing the cost of SAF, and increasing sustainability.

Department of Energy

DOE is the lead federal agency responsible for advancing research and development for the Sustainable Aviation Fuels Grand Challenge. Below are highlights of major DOE opportunities and priority areas:

- **Energy Earthshot Research Initiative and the Clean Fuels and Products Earthshot**. DOE launched the Energy Earthshots Initiative to drive innovation and accelerate adoption of clean energy technologies to help achieve the 2050 net-zero carbon goal. The most relevant to SAF is the Clean Fuels and Products Earthshot with a goal of lower greenhouse gas emissions for fuels and chemicals by 85 percent compared to current fossil-based sources by 2035. A major part of the goal is to support research, development, and demonstration activities to develop sustainable carbon resources to meet 100 percent of aviation fuel demand by 2050. DOE is pursuing five specific research areas as part of this initiative:
    - Mobilize biomass and waste feedstock;
    - Efficiently Capture and Convert CO2;
    - Develop carbon-efficient conversion processes;
    - Demonstrate integrated processes; and
    - Understand sustainability implications.

  If Congress provides final approval and funding in final fiscal year (FY) 2024 appropriations, DOE plans to release two funding solicitations in Spring 2024 to advance the Clean Fuels and Products Earthshot and SAF:

    - Up to $50 million for a **second Energy Earthshot Research Center** funding opportunity: Similar to the FY 2023 solicitation, DOE would support new multi-investigator, multidisciplinary centers to address the basic research challenges of the Energy Earthshots with clean fuels and products a high priority since it was not part of the last competition. The National Lab-led teams with research university collaborators would

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focus on energy-relevant research with a scope and complexity beyond what is possible in standard single investigator or small group awards.
    - Up to $25 million for a **second Energy Earthshot Research Foundation** funding opportunity: Similar to the FY 2023 solicitation, DOE would support small teams from research universities to advance key fundamental research challenges facing two or more of the eight Energy Earthshots. This solicitation is designed for research universities since DOE national labs are not eligible to lead applications. Awards will range from $500,000 to $2 million each per year over three years.
- $29 million for **Regional Resource Hubs for Purpose-Grown Energy Crops**: Concept papers due March 14 (*DOE plans to issue funding opportunities in FY 2025 and future years that would expand regions and crops participating in this initiative*)
    - DOE plans to fund up to five research groups focused on advancing low-carbon intensity, purpose-grown energy crops across varied agronomic and geographic areas.
    - The purpose is to develop feedstock data standards and procedures and find solutions to overcome regional resource mobilization challenges and barriers in four crops:
        - Algae; Herbaceous energy crops, such as switchgrass and miscanthus; Intermediate energy crops, such as carinata and pennycress; and Short-rotation woody crops, such as hybrid poplar and shrub willow.
    - These crops were selected based on the SAF Grand Challenge Roadmap and the research and development priorities in the Deploying Purpose-Grown Energy Crops for SAF workshop report.
    - Groups selected for funding are required to become members of the new DOE Regional Biomass Resource Hub Initiative, led by Idaho National Laboratory.
- Continued support for **biorefinery pilots and demonstration projects**. In 2023, DOE already invested $118 million in 17 projects focused on accelerating the production of sustainable biofuels, including SAF.

Department of Transportation

- The **Continuous Lower Energy, Emissions, and Noise (CLEEN) program** is the FAA's principal environmental effort to develop new technologies to reduce emissions. The CLEEN Program is implemented in five-year phases, and has goals for noise, fuel burn, and emissions. In 2010 the FAA initiated the first phase, entering into five-year agreements with Boeing, General Electric (GE), Honeywell, Pratt & Whitney (P&W), and Rolls-Royce. To receive funding from CLEEN, industry partners need to match or exceed the funds provided by the FAA. Through the first two phases of CLEEN, industry has contributed $388 million of cost share to the CLEEN Program, which has exceeded the FAA contribution of $225 million. Following subsequent successes under the second phase, the third phase of the CLEEN Program was launched in 2021 with research and development activities planned to *run through 2026*. A fourth phase of the program is in development, planned to run from 2025 through 2029. A market survey for CLEEN Phase IV was released in December 2022. A solicitation for proposals is expected to be released in 2024. For SAF, the CLEEN program goal is to develop "Drop-in" sustainable aviation fuels, including quantification of benefits. Drop-in fuels will require no modifications to aircraft or fuel supply

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infrastructure. Universities are able to partner with the current industry companies on the next phase of CLEEN. More information about the program can be found here.