December 20, 2019

The Honorable Kathy Castor
Committee Chair
Select Committee on the
Climate Crisis
U.S. House of Representatives
H2-359 Ford Building
Washington, DC 20515

The Honorable Garret Graves
Ranking Member
Select Committee on the
Climate Crisis
U.S. House of Representatives
H2-359 Ford Building
Washington, DC 20515

Dear Chair Castor, Ranking Member Graves, and Members of the House Select Committee on the Climate Crisis:

The Biotechnology Innovation Organization (BIO) is pleased to respond to the Select Committee's Request for Information (RFI) on how supportive public policy can help biotechnology reduce greenhouse gas emissions, enhance carbon sequestration, mitigate the effects of climate change, enhance response to public health emergencies, and speed the transition of the U.S. economy to one that is more bio-based -- benefitting the environment, public health, and our national economy.

Introduction

The United Nations (U.N.) has noted that "rapid and far reaching" transitions are necessary across industries if we are to limit the impacts of climate change[1]. Novel, innovative approaches to address domestic and global climate challenges are desperately needed. Fortunately, the application of biotechnology is advancing solutions to this problem, enabling dramatic productivity and sustainability shifts in agriculture and bio-based manufacturing, including the production of renewable fuels and chemicals.

BIO represents 1,000 members from this biotech ecosystem around a central mission – to advance public policy that supports a wide range of companies and academic research centers that are working to apply biology and technology in the energy, agriculture, manufacturing, and health sectors to improve the lives of people and the health of the planet.

Our members use technology to enhance cultivation and food production and produce sustainable biofuels, renewable chemicals, and bio-based products, which provide a cost-competitive alternative to petroleum's value chain that also generates added value through economic development, job creation, and environmental and public health. Companies are utilizing biological processes to

[1] [1] IPCC "Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C approved by governments" (Oct. 8, 2018) Available at: https://www.ipcc.ch/2018/10/08/summary-for-policymakers-of-ipcc-special-report-on-global-warming-of-1-5c-approved-by-governments/

convert biomass and waste feedstocks into everyday products while creating new markets for agricultural crops, crop residues, and waste streams – in addition to contributing to a circular economy.

Additionally, innovations in biotech can address human health challenges as a result of climate change. According to the World Health Organization (WHO), more than four million deaths occur every year as a result of exposure to outdoor air pollution. Using biotech innovations, we can enable green energy breakthroughs and bio-based manufacturing processes to limit air pollution and establish sustainable agriculture practices that can also sequester carbon from the atmosphere. Innovation can also insulate human populations from the expected increased emergence of infectious diseases and antimicrobial resistance (AMR) associated with climate change. The health impacts of climate change may be catastrophic, but biotech can prevent and mitigate these risks.

The continued growth of bio-based technologies will enable the United States to smoothly transition to a clean energy economy that mitigates climate change, spurs technological innovation, and creates new opportunities for job growth, particularly in America's rural heartland. This shift will require incentives that facilitate robust and steady investment and deployment of cutting-edge biotech innovation.

Executive Summary of Key Recommendations

The information outlined in this document illustrates the potential impact of biotechnology to address climate change across many sectors – from transportation, to agriculture, to manufacturing. Below are BIO's key policy recommendations with regards to corresponding questions in the RFI, which are expanded upon further in the document.

#1.a. Policies to Decarbonize Transportation

- Develop and support policies, such as the *Renewable Fuel Standard Integrity Act,* H.R. 3006, that work to establish certainty around the Renewable Fuel Standard (RFS), biofuel policy, to facilitate increased adoption for commerce and industries investing in sustainable solutions.
- Provide long-term tax credits and incentives for biofuel research and development, as well as facilities construction, to establish confidence in the investment community to advance green energy breakthroughs.
- Encourage adoption of additional Low Carbon Fuel Standards (LCFS) in the states and examine the potential role for a LCFS at the federal level.
- Provide adequate, mandatory funding for government programs such as the Department of Energy's Bioenergy Technologies Office (BETO) and USDA's Biorefinery Assistance Program to ensure biofuel producers have the financial assistance needed for research and development and to build biofuel infrastructure.

#1.c. Policies to Decarbonize Industry

- Provide adequate, mandatory funding to Farm Bill Energy Title programs, including the BioPreferred Program and the Biorefinery Assistance Program, to ensure renewable chemical and bio-based manufacturers have enough capital and access to markets for commercialized products.
- Allow renewable chemicals and advanced biofuels producers to utilize publicly traded Master Limited Partnerships to reduce tax burdens, grant access to more capital and increase liquidity for small and emerging companies, particular as they conduct research and development and build facilities.
- Existing renewable energy, manufacturing, or environmental tax incentive regimes should be opened to renewable chemicals, such as the bipartisan Renewable Chemicals Act, (S. 1980/H.R. 3149) introduced in the 115th Congress.

#5.a. Federal Investment in Innovation

- Provide adequate, mandatory funding to agency research programs, including DOE's Office of Energy Efficiency and Renewable Energy (EERE) and USDA's Agriculture and Food Research Initiative (AFRI), to continue driving public investment in innovations in energy efficiency and agriculture.
- Support the implementation of the administration's Executive Order on Modernizing the Regulatory Framework for Agricultural Biotechnology Products to create streamlined regulations that are risk- and science-based in order to foster American innovation and allow biology-driven climate solutions to go to market.
- Support and provide funding for legislation that advances research and provides greater federal coordination on the development of new innovations in synthetic biology and renewable chemical development to address climate change. Legislation includes the Engineering Biology Research and Development Act of 2019 and the Sustainable Chemistry Research and Development Act of 2019.

#5.b. Incentives for Public-Private Partnerships

- Work with the Department of Defense to increase investment in research and development of low-carbon energy solutions for use in the military fleet. Congress should analyze and seek to replicate existing effective program models that aim to address climate change, such as USDA's Flex Fuel and Farm to Fly programs.

#6. Policies to Decarbonize Agriculture

- Streamline regulations across agencies that are risk- and science-based and allow farmers to reduce agriculture's environmental impact with biology-driven innovations like biotech plants, animals, and microbes.
- Provide incentives to farmers for capturing carbon from all crops, not just existing energy crops.

- Expand Farm Bill programs, such as the Conservation Stewardship Program (CSP), to enable farmers to decrease inputs that contribute to climate change while increasing crop yields.

#7. Policies to Help Agriculture Adapt to Climate Change

- Provide a risk- and science-based regulatory pathway for products of animal biotechnology to be approved so that farmers and ranchers can better insulate themselves and our food production from the risks of climate change.

#9. Policies to Reduce non-GHG emissions (i.e. Methane, nitrous oxide)

- Support research and development of agriculture microbial technology and develop policies to ensure these innovations can qualify for tax incentives and funding from government programs.

#10. Acceleration of Carbon Removal

- Maintain the 45Q tax credits and expand the incentives for new technologies in agriculture to help drive investment of new innovations to capture carbon.

#11. Resilience and Adaptation

- Direct agencies to issue guidance to clarify regulatory pathways for the swift approval and deployment of new health technologies once an urgent need arises.
- Provide resources to incentivize development of new antimicrobials and to fulfill unmet surveillance and R&D needs.

#13. Policies to Support International Climate Action

- U.S. leadership must continue participating in international bodies, such as the U.N. and World Trade Organization (WTO), to ensure overly precautious approaches to new technologies across the globe do not stifle progress or inhibit access to potential markets.
- Develop a coordinated, cross-agency strategy to advocate for enabling science and technology to deploy climate solutions in international bodies.

<u>Request for Information Questions</u>

1. **What policies should Congress adopt to decarbonize the following sectors consistent with meeting or exceeding net-zero emissions by mid-century? Where possible, please provide analytical support that demonstrates that the recommended policies achieve the goal.**
    a. **Transportation**

Overview – Biofuels – A Key Solution to Decarbonizing Road Transport

In 2016, emissions from the transportation sector surpassed emissions from power plants for the first time since 1979[2] and remained the leading source in 2017 according to the U.S. Environmental Protection Agency.[3] In 2016, the average American drove 1,300 more miles than they did in 1992.[4] In order to avoid the most dangerous impacts of climate change, immediate changes to address emissions in the transportation sector are required.

Biofuels provide a strong solution to reducing emissions in road transport. Not only are biofuels inherently cleaner by utilizing renewable bio-based feedstocks, but the processes used to create these fuels provide even greater climate benefit than the processes used to create their conventional counterparts.

Biocatalysts, such as enzymes, lower energy requirements, increase reaction rates, and can reduce the number of process steps necessary to make chemical transformations. Enzymes are selective, specific, and have a high catalytic rate; they are more efficient, producing chemical products with higher purity and fewer byproducts or wastes. Enzymes are enabling biofuel producers to convert corn stover, wheat straw, wood chips, sawdust, waste, and sugarcane bagasse into fuel, and to collectively increase biofuel yield and energy efficiency throughout the sector. New bio-boosting chemicals are increasing biomass yields while eliminating the need for antibiotics in the feed bioproducts for livestock. Companies have commercialized enzymes for producing cellulosic ethanol from agricultural waste and are currently operating cellulosic biorefineries.[5]

We are already reaping the benefits of the development of advanced and cellulosic biofuels. The use of low-carbon biofuels, primarily used in passenger cars, has resulted in significant greenhouse gas reductions, with cumulative CO_2 savings of nearly 600 million metric tons (mmt) since the Renewable Fuel Standard (RFS) was enacted.[6]

The greenhouse gas emission reductions and benefits will only expand with the utilization of advanced and cellulosic biofuels in aviation and maritime use. Current federal policy supporting these fuels, the RFS, requires lifecycle greenhouse gas reductions of at least 50 percent versus the relevant petroleum-based alternative for a fuel to qualify as an advanced biofuel, and at least 60 percent for cellulosic biofuels. Existing advanced and cellulosic biofuel technologies are far surpassing

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[2] Plummer, B. "Power plants are no longer America's biggest climate problem. Transportation is" Vox (Jun. 13, 2016) Available at: https://www.vox.com/2016/6/13/11911798/emissions-electricity-versus-transportation

[3] Office of Transportation and Air Quality "Fast Facts on Transportation Greenhouse Gas Emissions 1990-2017" EPA (Jun. 2019) Available at: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100WUHR.pdf

[4] Hobbes, M. "Democrats' Baffling Blind Spot On Cars Transportation is the greatest source of greenhouse gases in the United States. Why are all the 2020 candidates so scared to say it?" HuffPost (Nov. 4, 2019) Available at: https://www.huffpost.com/entry/the-democrats-baffling-blind-spot-on-carbon-emissions_n_5da4db19e4b0cad669a9b705

[5] BIO "Industrial Biotechnology: A Unique Potential for Pollution Prevention" (Jul. 21, 2017) Available at: https://www.bio.org/industrial-biotechnology-unique-potential-pollution-prevention

[6] Unnasch. S. (2019) GHG Reductions from the RFS2 – A 2018 Update. Life Cycle Associates Report LCA. LCA.6145.199.2019 Prepared for Renewable Fuels Association. Available at: https://ethanolrfa.org/wp-content/uploads/2019/02/LCARFSGHGUpdatefinal.pdf

these requirements. As highlighted in an Environmental and Energy Study Institute (EESI) report, "according to Argonne's GREET model, an energy crop like miscanthus can have negative greenhouse gas emissions, meaning that over the crop's life cycle, carbon sequestration outweighs emissions. Argonne researchers show that, compared to gasoline, biofuel from energy crops can reduce emissions by 101 to 115 percent. Corn stover, a residue from corn, can reduce emissions by 90 to 103 percent."[7] As the industry improves its efficiencies and practices, the greenhouse gas reductions of approved advanced and cellulosic biofuels are likely to be substantially greater.

The development and expansion of algae and aquatic plant cultivation has great potential of the development of advanced biofuels. Microalgae are aquatic plants that can be induced to rapidly accumulate lipids, often greater than 60 percent of their biomass, while consuming large amounts of carbon dioxide. They can be cultivated using closed loop systems, open ponds, and photo-bioreactors, using less land, energy and water than land crops. The characteristics of algae biofuels include high flash point, biodegradability, and low or no aromatic or sulphur compound, so they are being used to produce a variety of biofuels such as bioethanol, bio-butanol, jet fuel, biodiesel, bio gasoline, green diesels, and methane.[8]

The environmental benefits of biofuels go beyond greenhouse gas reductions. According to the National Bureau of Economic Research, the United States saw fine particulate pollution increase 5.5 percent between 2016 and 2018.[9] According to the American Lung Association, State of the Air report for 2019, more than four in 10 Americans live in counties that have monitored unhealthy ozone or particle pollution.[10] The health impacts of air pollution are catastrophic. According to the World Health Organization, 4.2 million deaths every year occur as a result to exposure to ambient (outdoor) air pollution.[11]

Biofuels reduce tailpipe emissions of both hydrocarbons and carbon monoxide, which helps prevent the formation of ground-level ozone. Data from 222 EPA sensing sites show that ozone levels have fallen during the period in which ethanol blending increased.[12] Additional data from the University of Illinois-Chicago (UIC) show substantial reductions in particulate matter (PM) and benzene with the addition of biofuels.[13] The American Lung Association, Upper Midwest Region found

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[7] "Biofuels versus Gasoline" The Emissions Gap is Widening" EESI (Sep. 2, 2016) Available at: https://www.eesi.org/articles/view/biofuels-versus-gasoline-the-emissions-gap-is-widening#:~:targetText=Argonne%20researchers%20show%20that%20compared,for%20the%20RFS%20from%202010.

[8] Wen, Z. "Algae for Biofuel Production" Extension (Apr. 3, 2019) Available at: https://farm-energy.extension.org/algae-for-biofuel-production/

[9] Schumaker, E. "US air quality declines after years of improvement." ABC News (Oct. 28, 2019) Available at: https://abcnews.go.com/US/us-air-quality-declines-years-improvement/story?id=66582569

[10] "State of the Air 2019" American Lung Association Available at: https://www.lung.org/our-initiatives/healthy-air/sota/key-findings/

[11] Air pollution and health World Health Organization Available at: https://www.who.int/airpollution/en/

[12] Cooper, G. Real-World Ozone and Particulate Data Expose Fallacy of Minnesota Study. Renewable Fuels Association (RFA). (Dec. 18, 2014). Available at: http://www.ethanolrfa.org/2014/12/real-world-ozone-and-particulate-data-expose-fallacy-of-minnesota-study/

[13] Mueller, S. UIC Study PM and Benzene in Splash Blended Fuels with Ethanol. (May 2017). Available at: http://www.erc.uic.edu/assets/pdf/UIC_Cook_County_Slides.pdf

higher volumes of biofuels can reduce ozone-forming pollutants and evaporative emissions.[14] Using biofuels to reduce PM in transportation will enable us to promote a higher quality of life and reduce healthcare costs. According American Lung Association in California, the state's low carbon fuel standard has helped Californians avoid more than 200 premature deaths from pollution. Continued growth of advanced and cellulosic biofuels will reduce harmful compounds in transportation fuel, improving air quality and human health.[15]

Overview – Sustainable Aviation Fuels (SAF)– A Key Solution to decarbonizing air transport

The development of biofuels is critical for the advancement of sustainable air travel. Contrary to the ground transport sector, which can use electric energy, aviation has no near-term alternative to liquid hydrocarbon fuels.[16]

Currently, the global aviation industry produces two percent of all human-induced CO_2 and is responsible for 12 percent of emissions from all transport sources. The aviation industry has set an ambitious goal that, by 2050, net aviation carbon emissions will be 50 percent of what they were in 2005. Beginning next year, net carbon emissions from international aviation will be capped through carbon neutral growth. The aviation industry has identified biofuels as an excellent candidate for the development of sustainable aviation fuel (SAF), showing that these fuels have reduced the carbon footprint of aviation fuel by up to 80 percent over the full lifecycle.[17]

As the Commercial Aviation Alternative Fuels Initiative (CAAFI) illustrated earlier this year, aviation biofuels are on the cusp of rapid expansion and replication.[18] Due to the goals of the industry to decarbonize, there have been significant investments and partnerships between airlines, airports, governments, and biofuel producers.

The first flight using blended biofuel took place in 2008. Since then, more than 150,000 flights have used biofuels.[19] This summer, United Airlines made history "with the departure of the Flight for the Planet, the most eco-friendly commercial flight of its kind in the history of aviation." As part of these efforts, United used a 30/70 blend of low-carbon, sustainable aviation fuel provided by Boston-based World Energy and traditional jet fuel. The biofuel alone achieves a greater than 60 percent reduction in greenhouse gas emissions on a lifecycle basis compared to

[14] Clean Fuels: E85, American Lung Association, Upper Midwest Region Available at: https://www.cleanairchoice.org/fuels/e85.cfm
[15] Holmes-Gen, B. and Barrett, W. "Clean Air Future Health and Climate Benefits of Zero Emission Vehicles" American Lung Association in California (Oct. 2016) Available at: https://www.lung.org/local-content/california/documents/2016zeroemissions.pdf
[16] International Air Transport Association (IATA), "Sustainable Aviation Fuels Fact Sheet" Available at: https://www.iata.org/pressroom/facts_figures/fact_sheets/Documents/fact-sheet-alternative-fuels.pdf
[17] "Facts and Figures" Air Transport Action Group (Oct. 2019) Available at: https://www.atag.org/facts-figures.html
[18] Csonka, S. CAAFI, "General Industry Progress Update." (Apr. 4, 2019) Available at: https://www.biofuelsdigest.com/bdigest/2019/07/29/saf-on-the-cusp-of-rapid-expansion-and-replication-the-digests-2019-multi-slide-guide-to-caafi/
[19] Le Feuvre, P., IEA Energy Analyst "Commentary: Are aviation biofuels ready for take off?" (Mar. 18, 2019) Available at: https://www.iea.org/newsroom/news/2019/march/are-aviation-biofuels-ready-for-take-off.html

traditional jet fuel, and using biofuel is one of the most effective ways an airline can reduce its impact on the environment."[20]

The benefits of biofuels go beyond reducing greenhouse gas emissions. Based on findings in a cooperative international research program led by NASA and involving agencies from Germany and Canada, using biofuels to help power jet engines reduced particle emissions in their exhaust by as much as 50 to 70 percent.[21]

Overview – Biofuels – a Key Solution to Decarbonizing Maritime Transport

The development of biofuels is critical to reducing greenhouse gas emissions from the maritime sector. The international shipping industry emitted an estimated 812 mmt of carbon dioxide in 2015 – nearly 2.3 percent of the global total – and the industry's emissions are projected to double by the middle of this century. Development of biofuels can be used as an alternative to the bunker fuels that currently power the maritime industry.[22]

In 2016, the U.S. Navy Great Green Fleet demonstrated the potential of advanced biofuels in reducing emissions in maritime engines. Named to honor President Theodore Roosevelt's Great White Fleet, the year-long initiative in the John C. Stennis Strike Group (JCSSG) used alternative fuel sources, energy conservation measures, and operational procedures to reduce its fuel consumption. The fleet used biofuels made from 10 percent beef tallow provided from farmers in the Midwest and 90 percent marine diesel, and it was cost competitive with traditional fuels. It is used as a drop-in alternative, meaning no modifications to engines or operational procedures are required.[23]

Continued growth of advanced biofuels will be critical to meet the International Maritime Organization's (IMO) limit for sulphur in fuel oil used on board ships below 0.50 percent by January 1, 2020. Earlier this year, international container ocean carrier CMA CGM teamed up with the Port of Rotterdam, Ikea Transport & Logistics Services, and biofuel company GoodShipping to test biofuels made from used cooking oil and forest product residues. Not only did it "virtually eliminate" sulfur oxide emissions to meet the IMO goals, it delivered a reduction in carbon dioxide emissions of about 80 percent to 90 percent.[24]

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[20] United Airlines Press Release. "United Airlines Makes History Flying the Most Eco-Friendly Commercial Flight of its Kind." (Jun. 5, 2019) Available at: https://hub.united.com/united-most-eco-friendly--flight-2638700079.html

[21] National Aeronautics and Space Administration (NASA). NASA Study Confirms Biofuels Reduce Jet Engine Pollution. (Mar. 15, 2017). Available at: https://www.nasa.gov/press-release/nasa-study-confirms-biofuels-reduce-jet-engine-pollution

[22] Newman, M. "Clean Marine Fuel in 2020: An Opportunity for Biofuel?" BiofuelsDigest (Dec. 4, 2019) Available at: http://www.biofuelsdigest.com/bdigest/2019/12/04/clean-marine-fuel-in-2020-an-opportunity-for-biofuel/

[23] John C. Stennis Strike Group Public Affairs, "The Great Green Fleet Explained" U.S. Navy (Jun. 27, 2016) Available at: https://www.navy.mil/submit/display.asp?story_id=95398

[24] Wilson, J. "Marine biofuels begin to make headway in ocean shipping" Freight Waves (Mar. 14, 2019), Available at: https://www.freightwaves.com/news/maritime/imo2020-lowsulfurfuel-biofuel-trials

Supportive Policies to Decarbonize Transportation Fuels

Biofuels have made significant progress towards decarbonizing the transportation sector. However, to more substantially commercialize the advanced biofuels sector, properly address climate crises and other environmental challenges, and grow the economy, clear and stable policy support and implementation is essential.

The Renewable Fuel Standard

The Renewable Fuel Standard (RFS), a national policy that requires a certain volume of renewable fuel to replace or reduce the quantity of petroleum-based transport fuel, heating oil, or jet fuel, has spurred research and investment in the development of low-carbon biofuels. The RFS has enabled the United States to become a leader in the development and deployment of new technologies, which has led to the growth of the bio-based economy – benefitting farmers and commodity producers, helping revitalize rural economies, creating good paying jobs, and fostering energy independence.

Unfortunately, the program is not fully operating as intended and needs to be fixed. The demand destruction caused by the expanded issuance of small refinery exceptions (SREs) has had a major impact on the biofuels industry. EPA's expansion of granting SREs retroactively after setting the annual percentage standard for the RFS ensures that the proposed annual volume obligations will not be met with liquid biofuels, contrary to the statute and congressional intent.

Analysis from the U.S. Energy Information Administration found the roughly 72 SRE waivers effectively reduced the amount of biofuel required to enter the nation's fuel supply by 7.4 percent of the total RFS renewable fuel volume mandate for the 2018 compliance year, or about 1.43 billion gallons.[25]

As members of the bipartisan Congressional Biofuels Caucus highlighted in their September 20th letter to EPA Administrator Andrew Wheeler, these waivers are negatively impacting the economy across the country.[26] These waivers also undercut investment and development of advanced and cellulosic biofuels. As the letter noted, "these exemptions greatly outweigh the proposed [2020 RFS] rule's slight 0.12 billion gallon increase in advanced biofuel."[27] Undercutting demand for advanced and cellulosic biofuels will stifle innovation and drive down the demand for sustainable solutions that reduce greenhouse gas emissions in the transportation sector. Because of EPA's actions, the advancement of cellulosic biofuels has been held back, leading cellulosic facilities to pause production.[28]

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[25] Hanson, S and Hill, S. "EPA refinery exemptions reduced renewable fuel blending requirements in 2018" U.S. Energy Information Administration (Oct. 25, 2019) Available at: https://www.eia.gov/todayinenergy/detail.php?id=41794

[26] Peterson, C., Marshall, R. Loebsack, D., & Davis, R., "Congressional Biofuels Caucus Members Press EPA to Remedy Damage from SRE Waivers" U.S. House of Representatives (Sep. 20, 2019) Available at: https://www.scribd.com/document/427084785/09-20-2019-Final-Letter-to-Epa-2020-Rvos

[27] Ibid.

[28] Clayton, C. "Cellulosic Production Idled Citing EPA Decisions, POET-DSM Converting Cellulose Plant to Research, Development" Progressive Farmer (Nov. 19, 2019) Available at:

The expanded issuance of SREs is also having a negative impact on the environment. Removing biofuels from the transportation fuel market means an increasing dependence on unconventional sources and methods of oil production. Production-related emissions for petroleum from Canadian oil sands is nearly five times that of traditional crude, for example.[29] A recent NASA analysis suggests leaks of methane from fracking operations may also be contributing more than previously thought to atmospheric greenhouse gas concentrations.[30]

Beyond EPA's expanded issuance of SREs, delays and uncertainty surrounding the approval of pathways and registration for advanced and cellulosic biofuels are also hindering the development of the industry. As Representatives John Shimkus (R-IL) and Chellie Pingree (D-ME) state in their June 4, 2019 letter to Administrator Wheeler, "delays in review of new RFS pathway petitions have inhibited the growth and development of the next generation of innovative transportation fuels."[31]

While significant headway has been made in the past year and there are now only 22 pending pathway applications, many of the recent approvals have been conventional ethanol facilities receiving efficient producer pathways, rather than new advanced and cellulosic pathways. Expedient approval of new technology pathways would show both developers and investors that there is a way forward for new biofuel technologies and would provide confidence to producers that their technologies will be reviewed in a timely and fair process.

Isobutanol, which EPA has approved as a gasoline additive up to 16 percent volume,[32] is limited by outdated and unnecessarily restrictive regulations that can significantly impair the potential for this valuable additive to realize its market value and potential.[33] These restrictions are keeping a drop-in fuel that can be used in marine and recreational boat engines from greater distribution.[34]

In addition to delays in approving pathways for new technologies, EPA has delayed approving facility registrations for ethanol producers seeking to install technologies to make cellulosic biofuels from corn kernel fiber, which already has an approved

https://www.dtnpf.com/agriculture/web/ag/news/business-inputs/article/2019/11/19/citing-epa-decisions-poet-dsm-plant

[29] Union of Concerned Scientists, "Fueling a Clean Transportation Future, Smart Fuel Choices for a Warming World." (Feb. 9, 2016) Available at: https://www.ucsusa.org/clean-vehicles/clean-fuels/transportation-fuels-future

[30] Rasmussen, C. "NASA-led Study Solves a Methane Puzzle" NASA's Earth Science News Team (Jan. 3, 2018) Available at: https://www.nasa.gov/feature/jpl/nasa-led-study-solves-a-methane-puzzle

[31] Voegele, E. "Letter urges EPA to Process Pending RFS Fuel Pathway Applications." Biomass Magazine (Jun. 11, 2019) Available at: http://biomassmagazine.com/articles/16226/letter-urges-epa-to-process-pending-rfs-fuel-pathway-applications

[32] Pruitt, E.S. "Fuel Additive Registration 40 CFR 79.23) U.S. Environmental Protection Agency (Jun. 12, 2018) Available at: https://www.epa.gov/sites/production/files/2018-06/documents/fuel-additive-registration-isobutanol-2018-06-12-redacted.pdf

[33] Gevo "Subject: Biobutanol and Access to Fuels Market - Request for Immediate Relief" (Nov. 2019) Available at: https://gevo.com/education/biobutanol-and-access-to-fuels-market-request-for-immediate-relief/

[34] Ryan, C. "An Overview of Gevo's Biobased Isobutanol Production Process" (Feb. 2018) Available at: https://gevo.com/products/isobutanol-blendstocks-for-ethanol-free-fuel/

pathway under the RFS. This delay has kept millions of gallons of low-carbon[35] cellulosic biofuels from reaching the market.[36]

Industrial biotech companies are developing processes that use methanotrophs, algae, and other microbes to capture waste carbon in the form of methane, carbon oxide emissions, or gasified wastes and convert it to low carbon advanced biofuels. However, current RFS regulations prevent some of these technologies from qualifying under the statute.

Biomass sustainably harvested from forestry offers great opportunities to produce low-carbon biofuels and reduce greenhouse gas emissions. The October 2017 Northern California fires emitted as much CO_2 in one week as all of California's cars and trucks do over the course of a year. Globally it is estimated that wildfires make up five to 10 percent of annual global CO_2 emissions each year.[37] Sustainably sourcing this biomass for biofuels could provide additional incentive to reduce fire risks in forests. In order to achieve this goal, EPA must update its definitions of renewable biomass to allow planted trees, tree residue, or slash and pre-commercial thinning from federal lands or crops to be eligible under the RFS. EPA should also expand the definition of renewable biomass under the RFS to include trees established from natural regeneration silvicultural systems and process wood residue established from silvicultural systems; as well as renewable biomass from naturally regenerated forest land, residues, and byproducts from milled logs and pulpwood type logs. By clarifying the definitions of renewable biomass under the RFS would enable the U.S. to sustainably manage its forestry resources and make the U.S. Department of Energy's billion-ton study on biomass feasible.[38]

Congress must continue to exercise oversight over EPA to ensure the RFS drives investment in innovative, low-carbon biofuels as the law was intended to do. House Agriculture Committee Chairman Collin Peterson (D-MN) and Representative Dusty Johnson's (R-SD) legislation, the *Renewable Fuel Standard Integrity Act*, H.R. 3006, could bolster these oversight efforts. This legislation would require refineries seeking an exemption from the RFS to submit petitions in a timely manner so that any waivers granted would be prospectively reallocated to non-exempt obligated parties. It would also provide greater transparency by ensuring that key information surrounding small refinery exemptions is publicly disclosed. We urge Conress to support this policy as it was intended, by stopping unjustified exemptions, guiding EPA to agree to the correct volumes, and expediting pathway and facility approvals.

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[35] California Air Resources Board, Lifecycle Emissions of POET Biorefining (Sep. 10, 2018) Available at: https://ww3.arb.ca.gov/fuels/lcfs/fuelpathways/comments/tier2/t2n-1266_report.pdf

[36] Heller, M. "Industry faults EPA as Cellulosic Ethanol Production Lags." Greenwire (Aug. 22, 2018) Available at: https://www.eenews.net/greenwire/2018/08/22/stories/1060094987

[37] Berwyn, B "How Wildfires Can Affect Climate Change (and Vice Versa)" INSIDECLIMATE NEWS (Aug. 23, 2018) Available at: https://insideclimatenews.org/news/23082018/extreme-wildfires-climate-change-global-warming-air-pollution-fire-management-black-carbon-co2#:~:targetText=As%20a%20result%2C%20they%20estimate,global%20CO2%20emissions%20each%20year.

[38] U.S. Department of Energy. Billion-Ton Report: Advancing Domestic Resources for a Thriving Bioeconomy. (Jul. 2016) Available at: https://energy.gov/sites/prod/files/2016/12/f34/2016_billion_ton_report_12.2.16_0.pdf

Tax Incentives

Biofuel tax provisions supporting the development of advanced and cellulosic biofuels – particularly the Second Generation Biofuel Producer Tax Credit (PTC), the Special Depreciation Allowance for Second Generation Biofuel Plant Property, the Biodiesel and Renewable Diesel Fuels Credit, and the Alternative Fuel Vehicle Refueling Property Credit – are incredibly important to our companies that are making significant investments to create new agricultural supply chains, build infrastructure for liquid biofuels, and develop innovative new technologies. These credits have enabled our industry to create new jobs, contribute to rural prosperity, and diversify our nation's energy supply. For example, the biodiesel tax credit has supported the production of biofuels used in aviation.[39]

The expiration and continued on-again off-again nature of these incentives has created uncertainty for investors and the industry about the availability of these credits, jeopardizing the long-term investments necessary for the development of biofuels. While these tax incentives enjoy broad[40] bipartisan[41,42] support[43] for these tax incentives the short-term availability of them make it difficult for companies to make long-term planning decisions.

BIO applauds Congress for reaching an agreement to extend the Second Generation Biofuel Producer Credit for cellulosic biofuels and the Special Allowance for Second Generation Biofuel Plant Property to January 1, 2021 and the Biodiesel and Renewable Diesel Income Tax Credit through December 31, 2022 in the Taxpayer Certainty and Disaster Tax Relief Act of 2019.[44] While BIO is grateful for the short-term extension of these incentives, ensuring the growth of advanced and cellulosic biofuels industry will require long-term tax incentives to avoid creating uncertainty for investors and companies trying to raise capital.

House Ways and Means Subcommittee on Select Revenue Measures Chairman Mike Thompson's (D-CA) discussion draft of the Growing Renewable Energy and Efficiency Now (GREEN) Act is a positive step for the long-term extension of these incentives.[45] While this bill calls for a phase out of the Biodiesel and Renewable

[39] NATA and Industry Aviation Coalition Support Extension of Biodiesel Tax Incentive in letter to House Ways and Means Committee Chairman Richard Neal and Ranking Member Kevin Brady (Apr. 12, 2019) Available at: https://www.nata.aero/assets/Site_18/files/GIA/121SMS/Aviation%20Industry%20Coalition%20Support%20for%20Biodiesel%20credit%20extension%20Neal%20Brady.pdf
[40] Finkenauer, A. and Harder, J. "Biofuel Tax Credit Extension and Retroactivity" letter (Jun. 3, 2019) Available at: https://finkenauer.house.gov/sites/finkenauer.house.gov/files/documents/Second%20Gen%20Biofuels%20Extender%20Support.pdf
[41] Smith, A., Hollingsworth, T., and Loebsack, D. "Multi-year extension of the Second Generation Biofuel Producer Tax Credit" letter (Nov. 26, 2018) Available at: https://www.biotech-now.org/wp-content/uploads/2019/11/Second-Gen-Biofuels-Letter-11-26-18.pdf?_ga=2.27182452.850446835.1573066958-1287514846.1535039721
[42] Loebsack, D. and LaHood, D. "Extend Biodiesel Tax Incentive" letter (Feb. 11, 2019) Available at: http://kce.informz.net/KCE/data/images/Final%20Signed%20Feb%202019%20Loebsack%20LaHood%20Biodiesel%20Letter.pdf
[43] Finkenauer, A. and Horn, K. "Path Forward for Expired Clean Energy Tax Incentives" letter (Nov. 6, 2019) Available at: https://finkenauer.house.gov/sites/finkenauer.house.gov/files/3435_001.pdf
[44] Taxpayer Certainty and Disaster Tax Relief Act of 2019 Available here: https://amendments-rules.house.gov/amendments/HWC_103_xml1217190022572257.pdf
[45] Thompson, M. "Chairman Thompson, Ways and Means Democrats Unveil Growing Renewable Energy and Efficiency Now Act" Press Release (Nov. 19, 2022) Available at:

Diesel Credit, we would encourage the Congress to develop a long-term tax credit for SAF. A long-term SAF-specific blender's tax credit could attract significant investment to the sector and address existing structural and policy disincentives that have prevented the aviation biofuels industry from taking off. In addition, it will be critical for Congress to develop tax incentives for low-carbon fuels beyond the length of the GREEN Act to ensure new technologies that are currently being developed are properly incentivized.

BIO would encourage the Select Committee to register its support of advanced and cellulosic biofuel tax incentives as it did for other renewable technologies in its October 30th letter to House Ways and Means Committee Chairman Richard Neal.[46]

Low Carbon Fuel Standards

State initiatives bolster federal efforts to address transportation emissions. Low Carbon Fuel Standards (LCFS), such as California's state LCFS, have been a proven driver and alternative mechanism to decarbonize the transportation sector and incentivize biofuel producers to develop new low carbon fuels using sustainable sources like agricultural residues, industrial waste and even algae. Since 2011, the California LCFS has prevented more than 13.7 billion gallons of petroleum from being combusted on the state's roadways. This equates to avoiding 38 million tons of carbon pollution. This policy has increased the value of the clean fuels market by an estimated $2.8 billion.[47]

Because of the success of the California model, other states[48] and regions[49] are beginning to consider establishing their own LCFS programs to address emissions and air pollution at the state level. Establishment of these programs provides an additional value to biofuels, helping spur investment, production, and consumption of advanced biofuels. Congress should examine the success of state policies already in place, like that in California, and data projections from other states considering their own LCFS and determine an appropriate federal role for supporting or enacting LCFS models.

Bolstering Government Support Programs

Bolstering funding of U.S. Department of Energy (DOE), USDA renewable energy programs, and other government research programs is necessary for the growth of the advanced biofuels industry. DOE's Office of Energy Efficiency and Renewable

https://mikethompson.house.gov/newsroom/press-releases/chairman-thompson-ways-and-means-democrats-unveil-growing-renewable-energy

[46] Castor, K "CLIMATE CRISIS DEMS TO WAYS & MEANS: 'PRIORITIZE CLEAN ENERGY TAX POLICIES'" House Select Committee on the Climate Crisis (Oct. 30, 2019) Available at: https://climatecrisis.house.gov/news/press-releases/climate-crisis-dems-ways-means-prioritize-clean-energy-tax-policies

[47] California Delivers http://www.cadelivers.org/low-carbon-fuel-standard/

[48] Gladstein, C. "More States Follow California's Lead with Low Carbon Fuel Standard Programs" Advanced Clean Tech News (May 9, 2019) Available at: https://www.act-news.com/news/california-leads-with-low-carbon-fuel-standard-programs/

[49] Barber, J. "Could the RFS Move Toward a Low Carbon Program Like LCFS?" OPIS Blog (Jun. 17, 2019) Available at: http://blog.opisnet.com/rfs-lcfs

Energy (EERE) invests in clean energy technologies that strengthen the economy, protect the environment, and reduce dependence on foreign oil.

According to DOE's *Aggregate Economic Return on Investment in the U.S. DOE Office of Energy Efficiency and Renewable Energy,*[50] research and development (R&D) investments provide significant economic benefits. A total taxpayer investment of $12 billion (inflation-adjusted 2015 dollars) in EERE's R&D portfolio has yielded more than $388 billion in net economic benefits to the United States.

The Bioenergy Technologies Office (BETO) within EERE funds vital research and development of technologies to convert our nation's biomass resources into clean, renewable fuels. BETO recognizes that biofuels are especially needed in the aviation industry, where liquid fuels are still the only viable fuel source.

USDA's Biorefinery Assistance Program provides loan guarantees for the development, construction, and retrofitting of commercial-scale biorefineries that produce advanced biofuels. This program has enabled companies to put steel in the ground for first-of-a-kind biorefineries that are producing aviation biofuels. [51]

Federal Aviation Administration (FAA) programs are also critical to support the research and development, commercialization, and deployment of Sustainable Aviation Fuel. FAA's Office of Environment and Energy's R&D Program provides scientific understanding, development of new technologies, fuels and operations, and analyses to support achieving the Next Generation Air Transportation System (NextGen), and its goals of environmental protection that allow for sustained growth. The NextGen program is working with partners to develop solutions to reduce the impacts associated with aviation noise and exhaust emissions and increasing energy efficiency and availability. In alliance with research institutions and industry stakeholders, the program will accelerate the maturation of engine and airframe technologies to reduce aviation noise, fuel use, and emissions. FAA's Center of Excellence (COE) is charged with discovering, analyzing, and developing science-based solutions to the energy and environmental challenges facing the aviation industry. Through COE, FAA has been supportive of alternative jet fuel testing and analysis efforts through the ASCENT. This program is working collaboratively with its 16 main universities and five affiliate universities.

These programs have been vital to research and development and growth of the advanced and cellulosic biofuels sector. It is critical these programs remain fully funded and that Congress reject efforts to eliminate or reduce funding for these programs in the appropriations process.

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[50] Dowd, J. "Aggregate Economic Return on Investment in the U.S. DOE Office of Energy Efficiency and Renewable Energy." (Oct. 2017) Available at: https://www.energy.gov/sites/prod/files/2017/11/f39/Aggregate%20ROI%20impact%20for%20EERE%20RD%20-%2010-31-17.pdf

[51] USDA. Fletcher, J. (Press Release No. 0195.14). USDA Announces Loan Guarantee to Help Innovative Company Turn Waste Into Renewable Jet Fuel. https://www.usda.gov/wps/portal/usda/usdamediafb?contentid=2014/09/0195.xml

1. **What policies should Congress adopt to decarbonize the following sectors consistent with meeting or exceeding net-zero emissions by mid-century? Where possible, please provide analytical support that demonstrates that the recommended policies achieve the goal.**

    c. Industry

<u>Overview – Bio-based Manufacturing – A Key Solution to Decarbonizing Industrial Processes</u>

The development of the bio-based economy can revolutionize industry by creating a value chain of sustainable manufacturing that uses biological processes to convert renewable, low cost, or waste feedstocks into everyday products. It creates new markets for agricultural crops, crop residues and waste streams, as well as opportunities for innovation in producing consumer goods.

Supportive policy will drive investment and consumption of bio-based products and will bolster growth of a sustainable manufacturing sector that reduces greenhouse gas emissions and environmental impact.

According to the U.S. Energy Information Administration, U.S. chemical production uses 28 percent of the total energy used by all industrial sectors.[52] The USDA found that the development of renewable chemicals and bio-based products removed 12.7 mmt of CO_2 from the manufacturing sector in 2016 alone in its report, "An Economic Impact Analysis of the U.S. Biobased Products Industry".[53] This is due to the displacement of petroleum and reduction of fossil fuels in the manufacturing and use of bio-based products. The report goes on to note:

> The use of biobased products reduces the consumption of petroleum equivalents by two primary mechanisms. First, chemical feedstocks from biorefineries have replaced a significant portion of the chemical feedstocks that traditionally originate from crude oil refineries. Biorefineries currently produce an estimated 150 million gallons of raw materials per year that are used to manufacture biobased products. Second, biobased materials are increasingly being used as substitutes for petroleum-based materials, which have been used extensively for many years. An example of this petroleum displacement by a biobased material is the use of natural fibers in packing and insulating materials as an alternative to synthetic foams, such as Styrofoam. In this report we updated the oil displacement values from the 2016 report to reflect economic growth. In 2016 the estimated oil displacement is estimated to be as much as 9.4 million barrels of oil equivalents.

[52] U.S. Energy Information Administration "Use of Energy Explained, Energy Use in Industry" (2018) Available at: https://www.eia.gov/energyexplained/use-of-energy/industry.php
[53] Daystar, J., Handfield, R., Golden, J., McConnell, E., & Morrison, B., "An Economic Impact Analysis of the U.S. Biobased Products Industry" (Jul. 2018). Available at: https://www.biopreferred.gov/BPResources/files/BiobasedProductsEconomicAnalysis2018.pdf

In addition to the environmental benefits, USDA found that the value added to the U.S. economy by bio-based products was $459 billion in 2016. With employment in the industry increasing from 4.22 million jobs in 2014 to 4.65 million jobs in 2016.

Even greater reductions of greenhouse gas emissions are possible through the expansion of biotechnology in manufacturing. World Wildlife Fund found "if existing biotech solutions were used extensively in other traditional industries, such as detergent, textile, and pulp and paper manufacturing, another 52 million tonnes of greenhouse gas emissions reductions would be achieved annually."[54]

Biotechnology is also enabling the production of bio-based plastics providing a sustainable alternative to petroleum-based plastics. More than half of all plastic ever created was produced in the last 15 years, and right now, about 335 million tons of new, virgin plastic is created each year. Virtually all that new plastic will be made from oil and gas. Plastics now account for 3.8 percent of global greenhouse gas emissions and at the current rate will account for 15 percent of global emissions by 2050.[55]

Because bioplastics are derived at least in part from corn, sugarcane, or other plants, they have a smaller carbon footprint, with lower cradle-to-plant-gate greenhouse gas emissions than their fossil fuel-based counterparts.[56] Substituting the annual global demand for fossil-based polyethylene (PE) with bio-based PE would save more than 42 million tonnes of CO_2. This equals the CO_2 emissions of 10 million flights aground the world per year.[57] Replacing conventional 1,4-Butanediol (BDO) with bio-based BDO would save over seven million tons of greenhouse gas emission per year, or the equivalent of taking 1.5 million cars off the road.[58] In addition to reducing greenhouse gas emissions, bio-based BDO can produce compostable plastic packaging, reducing plastic waste.

All biomanufacturing processes – whether enzymatic or microbial – share the unique characteristic of avoiding use of toxic feedstocks and process reagents, which in turn minimizes toxic waste and byproducts. Manufacturers must manage byproducts of bioprocesses to prevent pollution.[59] Just as enzymes improve biofuel production, manufacturers are using enzymes commercially to produce pharmaceuticals and other chemical compounds, food ingredients, detergents, personal care products, textiles, and paper products, avoiding use of toxic feedstocks and process reagents, which in turn minimize toxic waste and

[54] Kornerup Bang, J., Follér, A. and Buttazzoni, M. "Industrial Biotechnology More Than Green Fuel in a Dirty Economy" WWF Available at: http://assets.panda.org/downloads/wwf_biotech.pdf
[55] Zheng, J. and Suh, S. "Strategies to reduce the global carbon footprint of plastics.' Nature Climate Change (Apr. 15, 2019) Available at: https://www.nature.com/articles/s41558-019-0459-z?utm_source=commission_junction&utm_medium=affiliate
[56] Hackett, M. "Bioplastics offer a smaller carbon footprint" HIS Markit (Nov. 20, 2018) Available at: https://ihsmarkit.com/research-analysis/bioplastics-offer-a-smaller-carbon-footprint.html
[57] "Environmental benefits of bioplastics" European Bioplastics Available at: https://www.european-bioplastics.org/bioplastics/environment/
[58] Schilling, C. "Sustainability and Social Responsibility Report" Genomatica (Jun. 2019) Available at: https://www.genomatica.com/wp-content/uploads/Genomatica-Sustainability-and-Social-Responsibility-2019.pdf
[59] Junker, B. (2010). "Minimizing the environmental footprint of bioprocesses." BioProcess International, Oct. 1, 2010. http://www.bioprocessintl.com/manufacturing/facility-design-engineering/minimizing-the-environmental-footprint-of-bioprocesses-303905/.

byproducts.[60] By utilizing enzymes, textile mills used less energy and reduced their CO_2 emissions by 12 mmt. This technology also has the added benefit of reducing the use of water in textile production by 8.1 billion cubic meters, equal to the annual consumption of 140 million households.[61]

Sugar from crops like corn and wheat can be fermented using yeast to create renewable bio-succinic acid, which is commonly used as an emollient or fragrance carrier in various skin creams and lotions. Succinic acid is effective in combating acne and reducing skin flakiness and wrinkles. By using biotechnology, many personal care products can be made using a range of renewable, sustainable resources, including agricultural feedstocks. Carbon captured from industrial processes can be captured, recycled, and fermented using microbes to create renewable non-toxic Isopropanol, a common alcohol used to extract and purify oils found in skin care products, such as acne treatments. Using synthetic biology, carbon-rich gases can be used to develop esters, a class of chemical compounds used to create certain aromas and fragrances in perfumes and cosmetics. By capturing and recycling these gases to be converted to esters instead of going into the atmosphere, environmental impact is reduced. Replacing petroleum-based butylene glycol with butylene glycol produced from a sustainable and renewable sugar fermentation process reduces greenhouse gas emissions by 51 percent and allows consumers to avoid petroleum-based ingredients in their personal care products.[62]

Biotechnology can also improve the environmental footprint of textiles. Replacing petroleum based paraxylene with a bio-paraxylene produced from a mix of sugar cane and corn-based ethanol results in a 70 percent reduction in carbon emissions. Bio-paraxylene can be used to produce a 100 percent bio-polyester. This can lead to a 25 percent to 50 percent reduction in carbon emissions when compared to petroleum based polyester products. Further bio-polyester produced using bio-paraxylene can be recycled in the same recycling infrastructure as petroleum-based polyester.[63]

Traditional carpets take up the second-largest amount of U.S. landfill space. Approximately 3.5 billion pounds of carpet are put in U.S. landfills every year. Carpets are made up of a complex array of chemicals, either made of nylon, polyester, or polypropylene. Biotechnology can manipulate the polyester to form every element of the carpet, from base to tufts, the flooring, when discarded, can be returned to the manufacturer, ground up, and repurposed as another carpet, reducing the need for petroleum to manufacture new carpet.[64]

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[60] Phillips, T. (2016) "Enzyme Biotechnology in Everyday Life." The Balance, Oct. 13, 2016. https://www.thebalance.com/enzyme-biotechnology-in-everyday-life-375750.
[61] Novozymes "Biological solutions on the catwalk to find answers for sustainable fashion" Trade new (May 14, 2019) Available at: https://www.novozymes.com/en/news/news-archive/2019/05/biological-solutions-on-the-catwalk-to-find-answers-for-sustainable-fashion
[62] Pacheco, R. and Huston, K. "Life Cycle Assessment (LCA) of Naturally-Sourced and Petroleum-Based Glycols Commonly Used in Personal Care Products" sofw journal (Nov. 15, 2018) Available at: https://www.genomatica.com/wp-content/uploads/SOFW-LCA-Article.pdf
[63] Virent, Sustainability Webpage, Available at: https://www.virent.com/technology/sustainability/
[64] Anzilotti, E. "The First 100% Recyclable Carpets Are Here" Fast Company (Feb. 21, 2017) Available at: https://www.fastcompany.com/3067849/the-first-100-recyclable-carpets-are-here

Supportive Policies to Decarbonize Industry

Farm Bill

The Farm Bill energy title programs have been critical to the growth of the bio-based economy. These programs have enabled innovative companies to develop and commercialize advanced biotech processes. The BioPreferred Program and Biorefinery Assistance Program are two key programs helping to decarbonize the industry and must be implemented and funded as intended.

BioPreferred

Managed by USDA, the goal of the BioPreferred program is to increase the purchase and use of bio-based products from agricultural feedstocks. The BioPreferred Program was created by the 2002 Farm Bill and reauthorized and expanded as part of the Agricultural Improvement Act of 2018 (the 2018 Farm Bill). The program's purpose is to spur economic development, create new jobs and provide new markets for farm commodities. The increased development, purchase, and use of bio-based products reduces our nation's reliance on petroleum, increases the use of renewable agricultural resources, and mitigates adverse environmental and health impacts.[65]

The BioPreferred Program is transforming the marketplace for bio-based products through two initiatives: purchasing requirements for Federal agencies and their contractors; and voluntary product certification and labeling. As highlighted above, the label is helping drive consumer recognition of bio-based products that are displacing about 300 million gallons of petroleum per year – the equivalent to taking 200,000 cars off the road.[66] However, while federal law, the Federal Acquisition Regulation, and Presidential Executive Orders direct all federal agencies and their contractors to purchase bio-based products in categories identified by USDA through the BioPreferred Program,[67] oftentimes federal agencies fail to give preference to bio-based products. To ensure the BioPreferred Program drives growth of the bioeconomy, Congress should ensure federal agencies follow through with the requirements to give preference to bio-based products and request a Government Accountability Office (GAO) report on federal agencies noncompliance to identify the problems to be addressed.

The largest challenge facing the BioPreferred program, which is significantly limiting its ability to assist with the decarbonization of industry, is that federal agencies are not adhering to the program's procurement requirements. By improving oversight and ensuring agencies are in compliance, it will improve effectiveness and boost the consumption of bio-based products with a lower carbon footprint. Moreover, driving

[65]USDA. What Is Biopreferred? https://www.biopreferred.gov/BioPreferred/faces/pages/AboutBioPreferred.xhtml
[66] Press Release "USDA Report Shows Growing Biobased Products Industry Contributes $393 Billion and 4.2 Million Jobs to American Economy" USDA (Oct. 3, 2016) Available at: https://www.usda.gov/media/press-releases/2016/10/03/usda-report-shows-growing-biobased-products-industry-contributes
[67] U.S. general Services Administration "Bio-Based and Bio-Preferred Products" GSA Available at: https://www.gsa.gov/governmentwide-initiatives/sustainability/buy-green-products-services-and-vehicles/buy-green-products/biobased-and-biopreferred-products

federal procurement will result in an economies of scale effect for producers, allowing for eased proliferation of bio-based products into the marketplace.

Biorefinery Assistance Program

The Biorefinery Assistance program provides loan guarantees to assist in the construction of advanced biofuels biorefineries. The 2018 Farm Bill updated the Biorefinery Assistance Program to provide eligibility for renewable chemical manufacturers and bio-based product manufacturers, in addition to advanced biofuels.

This loan guarantee program enables manufacturers to access capital for large-scale projects in rural communities. Without the loan guarantee program, new innovative companies might never be able to pool sufficient capital to commence development of a project in a rural community with a small population. Section 9003 has enabled companies to put steel in the ground for first-of-a-kind biorefineries. These biorefineries are proven job and economic growth drivers for rural communities.

The 2018 Farm Bill provides mandatory funding of $50 million for fiscal year 2019, and $25 million for fiscal year 2020.

While the mandatory funding for these programs in the 2018 Farm Bill is beneficial to the industry, increased funding will enable USDA to provide even greater support to the bio-based economy. As Congress looks to reauthorizing the next Farm Bill, continuation of these programs with greater funding will ensure continued growth of renewable chemical and bio-based manufacturing in rural communities.

<u>Tax Treatment</u>

To realize the full potential of the domestic renewable chemicals industry, existing renewable energy, manufacturing, or environmental tax incentive regimes should be opened to renewable chemicals. By providing a federal income tax credit for domestically produced renewable chemicals, Congress can create domestic jobs and other economic activity that can help secure America's leadership in the important arena of green chemistry. Like current law for renewable electricity production credits, the credits would be general business credits available for a limited period per facility. Introduced in the 115th Congress by Senator Debbie Stabenow (D-MI) in the Senate and Representative Bill Pascrell (D-NJ) in the House of Representatives, the bipartisan Renewable Chemicals Act, S. 1980/H.R. 3149, offers a strong model for implementation of this proposal.

Currently, sectors of the fossil energy industry can benefit from using the advantages of publicly traded Master Limited Partnerships (MLP). The renewable chemicals industry and the renewable energy sector (including advanced biofuels companies) cannot. The publicly traded MLP structure reduces a company's tax burden, enables access to capital at lower cost, and increases liquidity. Access to

capital is critical to the success of emerging industries, particularly as they develop their infrastructure.

Legislation to allow the advanced biofuels and renewable chemical sectors to be able to operate as publicly traded MLPs would provide parity among the different industry sectors. Introduced by Senators Chris Coons (D-DE) and Jerry Moran (R-KS) and Representatives Mike Thompson and Ron Estes (R-KS), the Financing Our Energy Future Act (S. 1841/H.R. 3249) offers a strong model for implementation of this proposal.

Expansion and extension of the 45Q tax credit to enhance the existing tax incentive for carbon capture, utilization, and storage (CCUS) at electric generating plants and industrial facilities will incentivize the adaptation of technologies to reduce emissions in the industrial sector. Adoption of CCUS, to capture waste carbon in the form of methane, CO_2 emissions, or gasified wastes and convert it to renewable and low-carbon chemicals, bio-based products, and advanced biofuels, is critical to addressing climate change. The promotion of CCUS can improve the emissions profile of biofuels, further reducing the carbon intensity of these sustainable fuels.

Maintaining the 45Q tax credits for CCUS will help drive investment development of innovative new technologies which can capture carbon. The one-year extension proposed in the recently introduced GREEN Act is a positive signal about the long-term availability of this credit.

Development of additional tax incentives to the chemical industry to produce less carbon-intensive products using less carbon-intensive feedstocks and manufacturing processes such as fermentation processes would accelerate the development of technologies to reduce greenhouse gas emissions in the industrial sector.

Congress should also explore the development of price support for lower carbon products relative to their carbon intensity. Similar to a low carbon fuel standard, it would provide greater market support for industrial products that reduce greenhouse gas emissions.

5. Innovation

a. Where should Congress focus on innovation agenda for climate solutions? Please identify specific areas for federal investment and, where possible recommend the scale of investment needed to achieve results in research, development, demonstration, and deployment.

<u>Overview – Research, Development, and Regulatory Streamlining – A Key Solution to Enabling Innovation for Developing Climate Solutions</u>

As highlighted earlier, the successful adoption and deployment of biotechnologies in agriculture and the development of the bio-based economy have been enabled by USDA and DOE research programs. USDA's Agriculture and Food Research Initiative

(AFRI) has been fundamental to the applied research, extension, and education to address food and agricultural sciences to improve rural economies and create new sources of energy. This program is essential for the foundational research and agricultural workforce development that complements and underpins large systems-level research, education, and extension activities needed to maintain America's global preeminence in food, agricultural, and bioenergy production. DOE's EERE invests in clean energy technologies that strengthen the economy, protect the environment, and reduce dependence on foreign oil. Advancement of these technologies have been critical in efforts to reduce greenhouse gas emissions across transportation, industry, and agriculture.

With the intensifying pace of research and development in biotechnology, new developments in synthetic biology and gene editing, and recent experience in engineering commercial-scale industrial biotech processes, it's critical that R&D and regulation keep pace for accelerated economic growth. Any policy surrounding these technologies must provide broad regulatory acceptance of, and where applicable, regulatory preference for, innovative and sustainable biotechnologies. In order to accelerate new industrial biotech breakthroughs, we must regain momentum and reignite investment in the bio-based economy through more far-reaching and predictable policies. Additionally, by carefully considering existing market barriers that are limiting the development or deployment of innovative solutions can drive investment in new climate solutions and allow their expedited use for curbing and mitigating climate change.

Supportive Policies to Advance Innovation for Climate Solutions

Regulatory Climate that Fosters Innovation

We discuss the beneficial role biotechnology has and can continue to play in curbing the climate impact of agriculture below in response to question 6. However, given how essential a predictable, streamlined, science-based regulatory system is for enabling investment in and deployment of innovative solutions, we felt it important to first address this issue in this section.

A regulatory climate that fosters innovation is an important component in meeting the goal of reducing greenhouse gas emissions and ensuring development of a set of precise yet flexible tools for meeting the agricultural and environmental challenges facing society more broadly. A 2011 study found that between 2008-2012, bringing a new plant biotechnology trait to market cost $136 million and took approximately 13.1 years, with regulatory requirements accounting for more than one-third of the time required. The study also projected these costs and timeframes to increase in future years.[68] These costly barriers for market entry have historically prohibited the participation of many academics and small- and medium-sized businesses in this sector and has unfortunately limited the deployment of these innovations to crops where these significant costs can be recouped.

[68] Phillips McDougall. "The cost and time involved in the discovery, development and authorisation of a new plant biotechnology derived trait." (Sept. 2011) Available at: https://croplife.org/wp-content/uploads/pdf_files/Getting-a-Biotech-Crop-to-Market-Phillips-McDougall-Study.pdf

To address these issues, the June 11th Executive Order on Modernizing the Regulatory Framework for Agricultural Biotechnology Products (E.O. 13874)[69] directs agency reforms that could facilitate the growth of technological innovation in agriculture for the foreseeable future. It is important to note that the reform directives set forth in E.O. 13874 are calls that have spanned multiple, bipartisan administrations.[70]

The E.O. directed the USDA Secretary, the EPA Administrator, and the FDA Commissioner to take specific actions to facilitate science-based, timely, efficient, and transparent oversight of agricultural biotech products. These agencies are to identify relevant regulations and guidance documents that can be streamlined and take steps as "appropriate and necessary" to accomplish such streamlining by December 8, 2019. The E.O. also required USDA, EPA, and FDA to "take steps to update its regulations and guidance, as necessary and appropriate, to remove undue barriers that impede small, private United States developers, the United States Government, and academic institutions from bringing innovative and safe gene edited-specialty crop plant products to the marketplace."

BIO recommends Congress monitor and support the implementation of this E.O. With prudent regulations, we can foster American innovation and bring to market biology-driven solutions that are reducing emissions, improving nutrition, reducing food waste, increasing crop yield, combating debilitating crop diseases, and advancing environmentally friendly farming practices.

Engineering Biology Research and Development Act of 2019, H.R. 4373

Engineering biology enables researchers to safely re-engineer existing biological systems and to learn from and mimic existing biological systems to perform novel tasks and develop novel materials and products. Technologies enabled by engineering biology are exciting and have the potential to solve some of society's greatest challenges, including providing food for a growing population, reducing our dependency on fossil fuels, and dramatically transforming manufacturing.

The bipartisan Engineering Biology Research and Development Act of 2019, H.R. 4373, introduced by House Committee on Science, Space, and Technology Chair Eddie Bernice Johnson (D-TX) and Ranking Member Frank Lucas (R-OK), would establish a framework for greater interagency coordination of federal investments in engineering biology-synthetic biology and lead to a national strategy for these investments. The bill would also focus on expanding public-private partnerships and on education and training for the next generation of engineering biology

[69] White House "Executive Order on Modernizing the Regulatory Framework for Agricultural Biotechnology Products (E.O. 13874) (Jun. 11, 2019) Available at: https://www.whitehouse.gov/presidential-actions/executive-order-modernizing-regulatory-framework-agricultural-biotechnology-products/

[70] White House "Modernizing the Regulatory System for Biotechnology Products: Final Version of the 2017 Update to the Coordinated Framework for the Regulation of Biotechnology" Available at: https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/2017_coordinated_framework_update.pdf

researchers. It would ensure that public engagement and outreach are an integral part of this research initiative.

BIO supports this legislation, which passed the full House of Representatives by voice vote on December 9, 2019. This bill is a promising step to improving coordination between agencies on the development of synthetic biology and to bolster the research and development of these technologies.

Congress should also look to existing programs to direct funding to further government support of research and development of these technologies to ensure the United States remains the leader in this innovative space.

Sustainable Chemistry Research and Development Act of 2019 (H.R. 2051/S. 999)

A March 2018 GAO report (GAO-18-307)[71] outlined how sustainable chemistry can inspire new products and processes, create jobs, and enhance benefits to human health and the environment. Despite the strong interest in sustainable chemistry from the private sector, there are still many barriers to its production.

The Sustainable Chemistry Research and Development Act of 2019 (H.R. 2051/S. 999) supports private sector innovation in sustainable chemistry by developing a coordinated national process to support research and development, commercialization, training, and education. These initiatives would provide the private sector with tools and collaboration to advance their innovation in sustainable chemistry and the products it enables.

The bill creates a national coordinating entity housed in the National Science and Technology Council to better align federal programs and activities in support of sustainable chemistry.[72] BIO supports this legislation and its goal to reduce barriers and support the continued design, development, and commercialization of sustainable chemical products and processes.

Toxic Substances Control Act (TSCA)

To promote the industrial biotech sector's commitment and contributions to global sustainability throughout the entire supply chain, a favorable and supportive regulatory structure for renewable chemicals is critical. BIO members have a strong interest in policies surrounding the Toxic Substances Control Act (TSCA) Inventory, including the new chemical reviews that lead up to placement on the Inventory, how bio-based chemicals are named on the Inventory, their equivalency to longstanding class 2 chemical listings on the Inventory, and the rules for protecting confidential business information (CBI) claims for TSCA Inventory listings. Further, BIO believes EPA's Chemical Data Reporting (CDR) rule serves as a vital information collection tool on the manufacture, use, and exposure of chemical

[71] "CHEMICAL INNOVATION: Technologies to Make Processes and Products More Sustainable" U.S. Government Accountability Office (Mar. 12, 2018) Available at: https://www.gao.gov/products/GAO-18-307
[72] GC3 Sustainable Chemistry Alliance, "Industry Supports the Sustainable Chemistry Research and Development Act of 2019" One Pager (Oct. 2019)

substances, and we support the agency's updates on the definition of a small manufacturer.

5. Innovation

b. How Can Congress incentivize more public-private partnerships and encourage more private investment in clean energy innovation.

<u>Overview – Public-Private Partnerships – Vital to Collaboration and Leveraging Resources to Develop Climate Solutions</u>

Public-private partnerships have been critical to the development of the bio-based economy. As discussed above, the U.S. Navy Great Green Fleet has demonstrated the potential of advanced biofuels in reducing emissions in maritime engines. In 2014, the Department of Defense working with USDA and DOE provided $210 million under the Defense Production Act towards the construction of biorefineries that produce cost-competitive, drop-in military biofuels.[73] As a result, these refineries are now coming online, capable of producing fuels for the military and aviation sector.

USDA has had several projects and partnerships with other Federal departments and organizations on furthering renewable energy and energy efficiency. This includes USDA partnering with states to develop infrastructure to increase biofuel distribution through its Flex Fuel Pump program. And under the Farm to Fly program, USDA worked with Boeing and Air Transport Association of America, Inc., to accelerate the availability of commercially viable and sustainable aviation biofuels in the United States to increase domestic energy security, establish regional supply chains, and support rural development.[74]

Local governments and municipalities also provide useful examples of how the government can increase the use of biofuels. The Port of Seattle and the State of Washington have worked with their partners in the WA State Aviation Biofuels Work Group to speed up the permitting and development of infrastructure of sustainable aviation fuels (SAF).[75] The San Francisco International Airport (SFO) signed a Memorandum of Understanding (MOU) with a group of eight airlines and fuel producers to work cooperatively on expanding the use of SAF at SFO.[76]

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[73] Lane, J. "US Navy, DOE, USDA award $210M for 3 biorefineries and mil-spec fuels" BiofuelsDigest (Sep. 19, 2014) Available at: http://www.biofuelsdigest.com/bdigest/2014/09/19/breaking-news-us-navy-doe-usda-award-210m-for-3-biorefineries-and-mil-spec-fuels/

[74] USDA "Special Projects and Partnership" Available at: https://www.usda.gov/our-agency/initiatives/energy/special-projects-and-partnerships

[75] Port of Seattle, "Sustainable Aviaiton Fuels" Available at: https://www.portseattle.org/page/sustainable-aviation-fuels

[76] Yakel, D. "SFO Announces Landmark Agreement for Use of Sustainable Aviation Fuels" (Sep. 5, 2018) available at: https://www.flysfo.com/media/press-releases/sfo-announces-landmark-agreement-use-sustainable-aviation-fuels

Supportive Policies to Promote Public-Private Partnerships for Climate Solutions

Despite the efforts by DOD to invest in biofuels, if the U.S. military were a country, it would be the 47th largest emitter of greenhouse gases in the world, slightly more than the entire country of Portugal. In 2017, the military bought about 269,230 barrels of oil a day, which, when burned, emitted more than 25,000 kilotonnes of CO_2.[77] Congress should work with the Department of Defense to increase investments in development and use of low-carbon biofuels in the military. Congress should also look to the creation and funding of programs similar to the Flex Fuel and Farm to Fly programs in order to jump start the increased use and distribution of advanced biofuels.

6. What policies should Congress adopt to reduce carbon pollution and other greenhouse gas emissions and maximize carbon storage in agriculture?

Overview – Innovation in Agriculture – Solutions to Reducing the Climate Impact of Agriculture While Bolstering the Bioeconomy

With proper policy incentives and regulations, innovative farming practices will provide the solutions to reducing greenhouse gas emissions not just in agriculture, but in energy and industry. Many of these solutions are win-win for farmers, rural communities, and our environment. Already, millions of farmers across the United States and around the world are using such practices made possible through biotechnology innovation.

According to the International Service for the Acquisition of Agri-biotech Applications (ISAAA),[78] biotech crops contributed to food security, sustainability and climate change solutions by:

- reducing CO_2 emissions in 2016 by 27.1 billion kg. This is equivalent to taking 16.7 million cars off the road for one year;
- conserving biodiversity by saving 452 million acres of land between 1996 and 2016, including over 137 million acres of land in 2016 alone;
- by preventing 671 million kg. of pesticide active ingredient from being released into the environment between 1996 and 2016, including 48.5 million kg in 2016 alone; and
- by reducing pesticide use by 8.2 percent between 1996-2016, and by 8.1 percent in 2016 alone;
- by reducing agriculture's EIQ (Environmental Impact Quotient) by 18.4 percent between 1996-2016.

[77] Locker, M. "The U.S. military emits more greenhouse gases than most countries" Fast Company (Jun. 28, 2019) Available at: https://www.fastcompany.com/90370924/the-u-s-military-emits-more-greenhouse-gas-than-most-countries

[78] Brookes, G. and Barfoot, P. "GM crops: global socio-economic and environmental impacts 1996-2016." PG Economics Ltd, UK (Jun. 2018) Available at: https://www.agrobio.org/wp-content/uploads/2016/03/globalimpactstudyfinalreportJune2018.pdf

New innovations such as gene editing[79] are contributing in other ways such as helping farmers grow food using less water, soil, fertilizer and pesticides, and by making climate-resilient plants and disease-resistant animals a reality. In addition, regenerative agriculture practices build organic matter back into the soil, effectively storing more water and drawing more carbon out of the atmosphere to reverse climate change.[80]

Overview – No-Till and Nitrogen-Fixation Technologies – Solutions for Improving Soil Management

It is well known that one of the largest agricultural contributors to greenhouse gas emissions is through soil management practices. EPA stated that in 2017, of the estimated 542.1 mmt of CO_2 equivalents that agriculture contributed towards the U.S. greenhouse gas emissions, approximately 266 mmt – or 49 percent – of those emissions were directly tied to soil management practices.[81] Much of this comes in the form of nitrous oxide, which has a particularly potent greenhouse effect even compared to CO_2, since CO_2 is readily reabsorbed from the atmosphere by vegetative matter while nitrous oxide is difficult to recapture once released and can spend decades or even over a century in the atmosphere before it is mitigated. Much of this nitrous oxide originates from the application of nitrogen-based fertilizers, which has the potential to mix with atmospheric or soil-based oxygen and release as nitrous oxide.[82]

No-till technologies, such as herbicide-resistant crops, which allow farmers to control weeds without tilling, are important because tilling can churn the soil, abetting this nitrous oxide release process.[83] No-till also has the added benefits of conserving topsoil from erosion and preventing fertilizers from entering waterways, which can contribute to dead zones in lakes and oceans.

Simply reducing or abandoning fertilizer application is not an option, however. Fertilizers improve the efficiency of agriculture immensely, and feeding our growing global population is dependent on efficient agricultural practices.[84] Reductions in yield and efficiency would likely result in opening more land globally to agriculture, resulting in increased deforestation and the destruction of natural carbon sinks, thus further contributing to climate change.

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[79] https://innovature.com/benefit/our-planet
[80] Wozniacka, G "Can regenerative agriculture reverse climate change? Big Food is banking on it." NBC News (Oct. 29, 2019) Available at: https://www.nbcnews.com/news/us-news/can-regenerative-agriculture-reverse-climate-change-big-food-banking-it-n1072941
[81] EPA "Inventory of U.S. Greenhouse Gas Emissions and Sinks" (2019) pg. 5-1, Available at: https://www.epa.gov/sites/production/files/2019-04/documents/us-ghg-inventory-2019-main-text.pdf
[82] EPA "Overview of Greenhouse Gases: Nitrous Oxide Emissions" Available at: https://www.epa.gov/ghgemissions/overview-greenhouse-gases
[83] Wallheimer, Brian. Perdue University News Service "No-till, rotation can limit greenhouse gas emissions from farm fields" (Dec. 20, 2010) Available at: https://www.purdue.edu/newsroom/research/2010/101220VynNitrous.html#:~:targetText=Tony%20Vyn%2C%20a%20professor%20of,the%20majority%20of%20surface%20residue.
[84] Ritchie, Hannah. Our World in Data, University of Oxford-Global Change Data Lab "How many people does synthetic fertilizer feed?" (Nov. 7, 2017) Available at: https://ourworldindata.org/how-many-people-does-synthetic-fertilizer-feed

Microbial inoculants can reduce reliance on chemical fertilizers such as phosphorus. Utilization of these technologies have improved crop yields while at the same time reducing the carbon footprint and addressing the concerns of chemical fertilizers. These technologies provide the added benefit of improving the overall lifecycle of biofuels and bio-based products produced from these feedstocks.[85]

Another solution that is rapidly emerging is developing new nitrogen-fixing plant varieties and techniques. Some crops, mostly legumes, have naturally developed a symbiotic relationship with soil bacteria, which pull nitrogen from the air and convert it to ammonia to meet the plant's nutritional needs.[86] Efforts are underway to genetically improve other common commercial crop varieties to develop a similar symbiosis with nitrogen-fixing bacteria.[87] There are also efforts to use bacteria as a seed-treatment to traditionally non-nitrogen fixing plants, significantly reducing their need for fertilizer applications.[88]

Plant biostimulants improve natural plant nutritional processes, which results in enhanced tolerance to abiotic and other environmental stresses that improves overall plant health, growth, quality and yield. In doing so, these products can increase the uptake and utilization of existing and applied nutrients. Plant biostimulants also can increase yield and quality without increasing applied fertilizer, water or planted acres, thus, sustainably enhancing the efficient use of these inputs and natural resources. Comprehensively, these technologies will not only result in a significant reduction in agriculture's climate and water-quality footprint, but it is a win-win for farmers, as the costs for their crop inputs and labor needs would decrease.

Overview – Enteric Fermentation in Ruminant Livestock – Technologies for Reducing Livestock Emissions

If agricultural soil management practices are the number one contributor of greenhouse gases in agriculture, enteric fermentation from ruminant animals – such as cows, sheep, goats, and buffalo – are a close second. These animals, which use microflora to assist in the digestion of otherwise indigestible starchy plants, such as grasses, produce significant volumes of methane as a byproduct of the digestive process.[89] This methane amounts to approximately 175 mmt CO_2 equivalent of methane produced every year, roughly one-third of the greenhouse gases produced by American agriculture annually.[90]

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[85] Novozymes "More from one acre" The Acre Study (Mar. 7, 2019) Available at: https://www.novozymes.com/en/news/news-archive/2017/03/more-from-one-acre-new-report
[86] New Mexico State University "Nitrogen Fixation by Legumes" Available at: https://aces.nmsu.edu/pubs/_a/A129/
[87] Hamilton, Eric. University of Wisconsin-Madison News "Corn that acquires its own nitrogen identified, reducing need for fertilizer" (August 7, 2018) Available at: https://news.wisc.edu/corn-that-acquires-its-own-nitrogen-identified-reducing-need-for-fertilizer/
[88] Molteni, Megan. Wired "Farmers Can Now Buy Designer Microbes to Replace Fertilizer" (Oct. 2, 2018) Available at: https://www.wired.com/story/farmers-can-now-buy-designer-microbes-to-replace-fertilizer/
[89] Food and Agriculture Organization of the United Nations "Reducing Enteric Methane for improving food security and livelihoods" Available at: http://www.fao.org/in-action/enteric-methane/background/what-is-enteric-methane/en/
[90] EPA "Inventory of U.S. Greenhouse Gas Emissions and Sinks"

Despite trends in plant-based protein, animal protein production is not expected to decrease any time soon. Not only has U.S. consumption of meat and poultry continued to increase,[91] but global animal protein consumption is expected to jump 15 percent by 2027, especially in areas with growing global middle classes with increased access to disposable income.[92] Solutions are needed to facilitate this expansion sustainably.

Existing innovations, such as feed additives for ruminant livestock, have been demonstrated to reduce methane levels in ruminant animals by up to 30 percent.[93] Further innovation in this area is critical to expand upon these environmental benefits as growth in animal protein production continues.

Overview – Food Waste – Addressing Waste and Inefficiencies Throughout the Supply Chain

Another driver of climate change in agriculture – a problem which spans the entire supply chain from farmer to consumer – is the issue of food waste. In addition to contributing to food insecurity abroad and domestically, the United Nations' Food and Agriculture Organization (FAO) estimates that approximately 30 percent of food across the globe is wasted, contributing up to eight percent of total global greenhouse gas emissions[94] through the need to increase production to compensate for lost food as well as the decomposition of wasted organic material.

There are practical steps Congress can take to mitigate food waste, such as encouraging greater manufacturer and grocer clarity and consistency on food expiration dates. However, this likely will only be able to address a fraction of the issue. To use an extreme example, the poor breeding of a consumer-favorite, the Honeycrisp apple, which bruises easily and does not store well, results in only 55 to 60 percent of the fruit making it to retailers.[95] FAO also estimates that between 20-40 percent of global crop production is lost to pests,[96] requiring farming additional acres to compensate for losses and further contributing to climate change.

The good news is there are genetic solutions that can address these problems. Tools such as gene editing can enable us to improve crop genetics to make them hardier, store better, and improve the volume of food that makes it to consumers.

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[91] National Chicken Council "Per Capita Consumption of Poultry and Livestock, 1960 to Forecast 2020, in Pounds" Available at: https://www.nationalchickencouncil.org/about-the-industry/statistics/per-capita-consumption-of-poultry-and-livestock-1965-to-estimated-2012-in-pounds/

[92] Maixner, Ed. Agri-Pulse "Plant-based, animal protein demand shows no sign of letting up" (Feb. 25, 2019) Available at: https://www.agri-pulse.com/articles/11933-plant-based-animal-protein-demand-shows-no-sign-of-letting-up

[93] Brown, H. Claire. The New Food Economy "This feed additive could significantly reduce methane-emitting cow burps" (Oct. 3, 2019) Available at: https://newfoodeconomy.org/feed-additive-methane-cow-burps/

[94] Frischmann, Chad. Washington Post, Opinion "The climate impact of the food in the back of your fridge" (July 21, 2018) Available at: https://www.washingtonpost.com/news/theworldpost/wp/2018/07/31/food-waste/

[95] Shanker, Deena and Mulvany, Lydia. The Morning Call "The Curse of the Honeycrisp Apple: Why Consumers Love it but Producers Hate it" Nov. 22, 2018) Available at: https://www.mcall.com/business/mc-biz-honeycrisp-apple-cost-20181112-story.html

[96] Food and Agriculture Organization of the United Nations "New standards to curb the global spread of plant pests and diseases" (April 3, 2019) Available at: http://www.fao.org/news/story/en/item/1187738/icode/

Other advances, such as reducing oxidization of apples, potatoes,[97] berries, avocados,[98] lettuce, and other foods that brown or spoil easily, not only will reduce waste on the consumer-end of the supply chain, but will also enable under-consumed fruits and vegetables to stay in the hands of consumers longer with the use of fewer preservatives.

Improving production for farmers has enormous benefits as well. Since its introduction in 1996, the use of insect-resistant corn has cumulatively reduced active ingredient insecticide use by more than 56 percent among countries that have adopted the innovation.[99] These production improvements are ways to enable farmers to grow more efficiently, all while using fewer acres and inputs, and ensuring the food that is grown will reach the intended consumers.

Supportive Policies to Reduce Greenhouse Gas Emissions and Maximize Carbon Storage in Agriculture

Regulatory Climate that Fosters Innovation

As highlighted in our recommendations to question 5. a., unclear, protracted regulatory pathways are one of the largest barriers to the deployment of innovative solutions that can address climate change. Indeed, it is often the case that novel, environmentally preferable approaches to product development face more significant regulatory hurdles than traditional – and less environmentally friendly – approaches. Efforts such as E.O. 13874 and other regulatory improvement initiatives can significantly help in developing sustainable, climate-resilient, farming systems. Advancing the adoption of innovations and technology for agricultural production and sustainable rural development policies will require a regulatory climate that fosters innovation and advances the adoption of technology.

Within modernizing the regulatory framework for agricultural biotechnology products, USDA should finalize proposed revisions to its agricultural biotechnology regulations (7 CFR Part 340) that appropriately reflect these new innovations. EPA should publish guidance or regulation to clarify under what circumstances, if any, products of gene editing would be subject to FIFRA registration. FDA should publish guidance clarifying whether and how food and feed derived from gene edited plants will be subject to its consultation process. The relevant agencies should promote favorable regulation of fermentation-based food, flavors, proteins, feed, and ingredients.

Regarding biostimulants, because of the broad applications of these tools, the regulatory pathways are even less clear and predictable. Section 10111 of the 2018 Farm Bill directed the Secretary of Agriculture to submit a report to the President and Congress that identifies any potential regulatory, non-regulatory, and

[97] International Service for the Acquisition of Agri-biotech Applications "Argentine Scientists Develop Non-Browning Potatoes Using CRISPR" (May 23, 2018) Available at: http://www.isaaa.org/kc/cropbiotechupdate/article/default.asp?ID=16472

[98] Yaffe-Bellany, David. Washington Post "Avocado Toast, Meet Gene Editing" (Sept. 27, 2019) Available at: https://www.nytimes.com/2019/09/27/business/avocados-genetic-modification.html

[99] Brookes, G. and Barfoot, P.

legislative recommendations on uniform labeling and availability of plant biostimulant products. BIO encourages Congress to conduct oversight and follow-up on the directed report to formulate a clearer, more predictable path to market.

In addition to addressing expiration dating issues, Congress can further incentivize food waste solutions by better highlighting the problem for the general public, which is still largely unaware of the problem and could help address the problem by behavioral adaptations. However, to allow for the further development and deployment of products, Congress should also better fund research focusing on this challenge and create an improved regulatory path to put innovations in the hands of farmers and consumers.

Providing broad and expedited regulatory acceptance of these technologies will promote innovative, sustainable technologies that can address greenhouse gas emissions.

Enhance Conservation Programs in the Farm Bill

The Farm Bill's Conservation Stewardship Program (CSP) is for working lands, with more than 70 million acres of productive agricultural and forest land enrolled in the program. CSP assists producers in protecting grazing land uses; conserving and improving soil, water and wildlife resources; and achieving related conservation values by conserving eligible land through grassland conservation contracts.[100]

The 2018 Farm Bill also contains a new and strategic climate-friendly pilot program that incentivizes and rewards carbon performance on farms. The program designates funding for a pilot project to incentivize farmers to adopt practices that improve soil health and increase carbon levels, while establishing protocols for measuring the gains in soil carbon resulting from those practices. This is a crucial step toward monetizing a new agricultural product—carbon capture and storage.[101]

Expansion of these programs will enable farmers to decrease inputs while increasing crop yields. Not only does this reduce the emissions in agricultural practices, it improves the lifecycle emissions of biofuels and bio-based products derived from biomass.

Utilize Carbon from All Biomass

To incentivize agricultural producers to reduce carbon emissions in products, Congress should develop policies that provide incentives to capture biomass carbon from all crops, not just energy crops. Straw, stover, crop residues, and manure can be utilized in the production and conversion of biogas into renewable fuel, renewable electricity, and renewable chemicals and bio-based products.

[100] Conservation Stewardship Program (CSP) USDA Natrual Resources Conservation Service https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/
[101] Lederer, N. "New Farm Bill Promotes Healthy Soils and a Healthier Climate" E2 Blog (Dec. 12, 2018) Available at: https://www.e2.org/blog/new-farm-bill-promotes-healthy-soils-and-a-healthier-climate/

7. What policies should Congress adopt to help farmers, ranchers, and natural resource managers adapt to the impacts of climate change?

Overview – Plant Biotechnology– Biotechnology Solutions to Enable Plant Improvement in the Face of Climate Change

Many technologies previously discussed in response to question 6, such as the use of gene editing, can be used to help farmers adapt to climate change as much as they can help its prevention through lowering their carbon footprint. For example, as water resources become scarcer due to climate change, drought-tolerant biotech crop varieties will enable farmers to retain their productivity by overcoming increased abiotic stresses.[102] Biotechnology is also being employed to develop resilience to other climate change-induced challenges. As ocean levels rise, coastal rice paddies around the world will be under a greater threat of flooding. Developing salinity-tolerant varieties will enable producers to retain yields in the face of these emerging challenges.[103]

Overview – Animal Biotechnology– Improving Animal Genetics to Adapt to (or Mitigate) Climate Change

Improvement of animal genetics will also be a critical aspect to helping livestock producers around the world adapt to climate change. Globally, but especially in tropical and sub-tropical environments, protecting herds from increasing temperatures expected with climate change will be very important. Research is currently being done to improve animal genetics, such as in cattle, to adapt to expected increasing temperatures.[104]

It is important to note that, while these technologies can improve animal genetics to develop resiliency, they can also help to mitigate climate change. Improvements in animals to produce more meat or milk will allow for the reduction of the total number of animals in production, thus reducing the aggregate environmental impact (see also comments regarding enteric fermentation in response to question 6). For example, even though there are fewer than half the dairy cows in the United States today as there were in 1950s, average milk production per cow has nearly doubled, largely because of genetic improvements through traditional breeding.[105] While these improvements took over 60 years to accomplish, the use of technologies, such as gene editing, could allow us to make similar improvements in a fraction of the time.

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[102] International Service for the Acquisition of Agri-biotech Applications "Pocket K No. 32: Biotechnology for the Development of Drought Tolerant Crops" Available at: https://www.isaaa.org/resources/publications/pocketk/32/default.asp

[103] Zhang, et. al. Molecular Breeding "Enhanced rice salinity tolerance via CRISPR/Cas9-targeted mutagenesis of the *OsRR22* gene" (March 9, 2019) Available at: https://link.springer.com/article/10.1007/s11032-019-0954-y

[104] Norman, Abby. Futurism "Scientists Want to Genetically Engineer Heat-Resistant Cows to Survive Climate Change" (June 29, 2017) Available at: https://futurism.com/scientists-want-to-genetically-engineer-heat-resistant-cows-to-survive-climate-change

[105] Bowden, Bridgit. Wisconsin Public Radio "How We Produce More Milk With Fewer Cows" (March 28, 2017) Available at: https://www.wpr.org/how-we-produce-more-milk-fewer-cows

Supportive Policies to Help Farmers and Ranchers Adapt to Climate Change

In response to questions 5.a. and 6, we have discussed the importance of developing a regulatory environment that is conducive to supporting innovations needed to address climate change. The plant innovations discussed above in response to question 7 would be subject to the same regulatory systems under USDA, FDA, and EPA that could significantly benefit from regulatory improvement to increase efficiency, reduce costs, and more quickly deploy climate solutions. As discussed, this is currently the subject of reform efforts under E.O. 13874, which BIO recommends Congress monitor and support to achieve the most predictable, streamlined, and science-based regulatory system as possible.

However, with animal biotechnology, there is a unique set of challenges. FDA regulates these animal innovations and has opted to adopt a very cumbersome regulatory approach that has stifled innovation in this sector. FDA treats the DNA of any animal with intentionally altered genome as an "animal drug" under the Food, Drug, and Cosmetics Act, and regulates it accordingly. This approach has produced several challenges, both pre- and post-market. First, the regulatory pathway is remarkably prolonged. Since FDA started regulating these animals in the mid-1990s, only one genetically-altered food animal has ever been approved by the agency, and that took nearly 20 years.[106] Second, there are post-market challenges with claiming the animal contains a "drug." This approach could trigger consumer acceptance issues and non-tariff trade barriers from our trading partners seeking to prohibit imports of U.S. products due to the animals containing unapproved "drugs," even if the "drug" is the animal's own DNA. BIO encourages Congress to direct the agency to adopt a regulatory approach more conducive to the deployment of these innovations.

9. What policies should Congress adopt to reduce emissions of non-CO_2 greenhouse gases, including methane, nitrous oxide, and fluorinated gases?

Overview – Microbial Technologies – Solutions to Capture or Reuse Non-CO_2 Greenhouse Gasses

As discussed in our comments regarding no-till and nitrogen-fixation technologies on question 6, biotechnology stands to offer significant reduction benefits for nitrous oxide and other non-CO_2 greenhouse gasses.

In addition, and beyond these significant reductions, the use of microbial technologies has also demonstrated that it can efficiently capture and convert methane, nitrous oxide, and other potent gases into renewable chemicals and bio-based products. For instance, biotechnologies using methanotrophs and other microorganisms, such as E. coli, have already demonstrated the feasibility of

[106] Ledford, Heidi. Nature "Gene-edited animal creators look beyond U.S. market" (February 20, 2019) Available at: https://www.nature.com/articles/d41586-019-00600-4

converting natural gas and methane into proteins for animal feed, biodegradable and recyclable polymers, biofuels, and other bio-based products.[107]

Supportive Policies to Enable Microbial Capture or Reuse of Non-CO_2 Greenhouse Gasses

Congress should support further research and development of these technologies, as well and develop policies to ensure these technologies can qualify for tax incentives and funding for other government support programs.

10. How Can Congress accelerate development and deployment of carbon removal technology to help achieve negative emissions?

Overview – 45Q Tax Credit – Solutions to Incentivize Carbon Removal Technologies

As discussed under 1. c. and further below, the 45Q tax credit for CCUS can accelerate development and deployment of carbon removal technology to help achieve negative emissions. Expanding this credit to capture additional carbon sequestration methodologies will further accelerate the development of these technologies.

Supportive Policies to Develop and Deploy Carbon Removal Technology to Help Achieve Negative Emissions

Support Section 45Q Tax Credit

As highlighted earlier in our comments, Section 45Q of the tax code provides an incentive for the adoption of CCUS. This monetizes carbon to produce valuable products. Capturing waste carbon from power plants and manufacturing facilities can be converted into valuable products such as advanced biofuels, animal feed, and chemicals. As a result, CCUS helps displace petroleum and other carbon feedstocks. Already, integrating CCUS with biofuels projects is producing negative emissions fuels.[108]

Expand 45Q Tax Credit for Carbon Capture Projects to Agriculture

Current land management practices result in the loss of more than 75 billion tons of topsoil per year, costing the world about $400 billion annually, or about $70 per person per year. Senator Michael Bennet (D-CO) recently unveiled a discussion draft to incentivize farmers and ranchers to capture carbon in the land.[109]

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[107] Nguyen, L.T., Lee, E.Y. Biotechnology for Biofuels "Biological conversion of methane to putrescine using genome-scale model-guided metabolic engineering of a methanotrophic bacterium" (June 15, 2019) Available at: https://biotechnologyforbiofuels.biomedcentral.com/articles/10.1186/s13068-019-1490-z#citeas

[108] Burgess, M. "Velocys signs CCUS agreement with Oxy to produce negative emission fuels" Gasworld (Oct. 10, 2019) Available at: https://www.gasworld.com/velocys-signs-ccus-agreement-with-oxy/2017915.article

[109] Bennet, M. "Bennet Unveils Discussion Draft to Create New Tax Credit for Farmers and Ranchers to Capture Carbon in the Land Sector." Michael Bennet (Dec. 13, 2019) Available at

One potential path to increasing carbon stocks is the development of improved crops that impart more carbon into the soil through their roots or grow deeper root systems. Using soil amendments is recognized as one of the most highly effective solutions to addressing climate change. This technology can enhance the soil microbiome, maximize root growth and foliar canopy, improve nutrient uptake, and ultimately supercharge photosynthesis—the plant's natural ability to pull carbon out of the atmosphere. Further, advanced root systems increase soil organic matter, can improve soil structure, fertilizer use efficiency, water productivity, crop yield, and climate resilience, and can mitigate topsoil erosion – all of which provide near-term and sustained economic value. Where these technologies have been deployed, the soil has sequestered an additional 3.3-8.6 metric tons of CO2 equivalents per acre in just the first year.[110] Taken over the 395 million acres of actively managed U.S. cropland, such advances could mitigate approximately 10 percent of total U.S. greenhouse gas emissions annually over a multi-decade period, according to the Advanced Research Project Agency-Energy (ARPA-E).[111]

The Section 45Q provides a performance-based tax credit to power plants and industrial facilities that capture and store CO_2 that would otherwise be emitted into the atmosphere. Expanding the credit to new technologies that are being developed to amplify soil carbon sequestration through forestry and crops would incentivize producers to utilize this technology reducing atmospheric carbon.

11. What policies should Congress adopt to help communities become more resilient in response to climate change?

<u>Overview –Emerging Infectious Diseases – Enabling Rapid Response Solutions to Emerging Diseases Corresponding to a Changing Climate</u>

Since the turn of the century, there has been a noticeable uptick in the frequency of emerging infectious diseases as rising temperatures and CO_2 levels contribute to the trophic restructuring of ecosystems, contamination of water and air, and acceleration of pathogen transmission rates. Higher temperatures make larger areas of land more habitable by certain vectors, increasing their range.[112] Greater mosquito ranges have led to the recent spread of dengue to the southwestern United States, and of Zika throughout South America and the Caribbean in 2016. Scientists estimate that the increased ranges of *Aedes aegypti* and *Aedes albopictus* will put nearly 50 percent of the world's population at risk for diseases like yellow

https://www.bennet.senate.gov/public/index.cfm/2019/12/bennet-unveils-discussion-draft-to-create-new-tax-credit-for-farmers-and-ranchers-to-capture-carbon-in-the-land-sector

[110] Locus Agricultural Solutions "New Unmatched Carbon Sequestration Data Highlights Immediate Solution to Climate Change" Press Release (Aug. 7, 2019) Available at: https://locusag.com/carbon-sequestration-data-highlights-immediate-solution-to-climate-change/

[111] ROOTS "Rhizosphere Observations Optimizing Terrestrial Sequestration" ARPA-E (Dec. 15, 2016) Available at: https://arpa-e.energy.gov/?q=arpa-e-programs/roots

[112] Ryan, Calrson, Mordecai, and Johnson. PLOS Neglected Tropical Diseases "Global expansion and redistribution of *Aedes*-borne virus transmission risk with climate change" (March 28, 2019) Available at: https://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0007213

fever, dengue, chikungunya, and Zika.[113] Additionally, factors contributing to the climate crisis such as urbanization and deforestation put different animal species and humans in closer contact, leading to more frequent zoonotic disease transmissions, and more rapid transportation makes quick spread of these diseases more likely.[114] Examples of this include the multiple Ebola outbreaks in West Africa and the Democratic Republic of Congo over the past five years and MERS in the Middle East in the mid-2010s.

The 2014-16 Ebola outbreak in West Africa showed that, despite herculean efforts among public and private partners to accelerate vaccine development and shorten timelines, our current paradigm is still too slow. Platform technologies offer the possibility to accelerate the research and development for vaccines against newly emerging infectious diseases or re-emerging infectious diseases when time is not on our side.

A 2019 report by the Johns Hopkins Center for Health Security, "Vaccine Platforms: State of the Field and Looming Challenges," defined platforms as technologies where "an underlying, nearly identical mechanism, device, delivery vector, or cell line was employed for multiple target vaccines."[115] Vaccine platforms may be built upon a variety of biotechnology tools: viral vectors, nucleic acid (RNA or DNA), or expression platforms.[116] Through this "plug-and-play" approach, platforms have the potential to lead to the development of multiple vaccines through a more unified R&D approach. When a new infectious disease emerges, companies can more easily pivot existing research to test their platform against the pathogen, building upon proven technologies, streamlining R&D, shortening timelines, and lowering development costs.

The use of platform technologies in vaccine development is a relatively novel approach, and FDA's approach toward the regulatory issues associated with platforms is unclear. The FDA has asserted that they license products, not platforms,[117] but how they will consider the benefits of platforms in the R&D requires clarity. The Department of Health and Human Services' (HHS) Biomedical Advanced Research and Development Authority (BARDA) is currently partnering with companies on vaccine R&D utilizing platforms for emerging infectious diseases, but their work is essentially an unfunded mandate. Section 404 of the 2019 reauthorization of the Pandemic and All-Hazards Preparedness Act (PL 116-22, S. 1379) includes R&D of products for emerging infectious diseases as within BARDA's remit, but the bill failed to provide a corresponding authorization level for this work.

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[113] Yale Environment 360 "Climate Change Will Expose Half of World's Population to Disease Spreading Mosquitoes by 2050" (March 5, 2019) Available at: https://e360.yale.edu/digest/climate-change-will-expose-half-of-worlds-population-to-disease-spreading-mosquitoes-by-2050

[114] Patz, Epstein, Burke, and Balbus. Journal of the American Medical Association "Global climate change and emerging infectious diseases" (Jan. 17, 1996) Available at: https://www.ncbi.nlm.nih.gov/pubmed/8604175

[115] Adalja, Watson, Cicero, Inglesby. "Vaccine Platforms: State of the Field and Looming Challenges" Page 4. (April 23, 2019) Available at: http://www.centerforhealthsecurity.org/our-work/publications/2019/vaccine-platforms-state-of-the-field-and-looming-challenges

[116] Ibid. Page 12.

[117] Ibid. Page 5.

Overview –Antimicrobial Resistance – Addressing the Correlation Between Antimicrobial Resistance and Climate Change

While the development of resistance by pathogens to antibiotics, antivirals, and antifungals is impacted by a variety of factors, scientists have found that an increase in temperature across a region is associated with increased biofilm formation[118] and associated antimicrobial resistance (AMR). One study found that a 10º C difference resulted in a 4.2 percent increase in the rate of resistance of *Escherichia coli,* a 2.2 percent increase in the resistance of *Klebsiella pneumoniae,* and a 2.7 percent increase in the resistance of *Staphylococcus aureus.*[119] Additionally, a recent study found that climate change may have played a role in accelerating the emergence of *Candida auris,* a fungal infection that can often be resistant to antimicrobial treatments.[120]

AMR is a dire public health problem globally and in the United States. The Centers for Disease Control and Prevention's (CDC's) report, "Antibiotic Resistance Threats in the United States, 2019" estimates that more than three million AMR infections occur in the U.S. annually, with 49,000 deaths as a result.[121] These numbers will only keep rising in the face of the climate crisis.

Mitigating the impact of the climate crisis on AMR will require new antimicrobial products. Concerningly, the AMR product pipeline is in grave danger of collapse, as the small companies currently responsible for the majority of antibiotic innovation struggle to stay in business.[122,123] Additional failures would be catastrophic to a pipeline that is already inadequate to meet the current AMR threats facing our patients.

Urgent action is needed to implement a package of incentive policies that address the unique market challenges of AMR products. This package should include policies that address reimbursement challenges for antimicrobials that also impact patient access to these medicines. It should also include a pull incentive that rewards the successful approval of innovative antimicrobials that treat unmet medical needs. This package will help ensure we are prepared to meet the rising threat of AMR.

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[118] Kent, Garcia, Martiny. Nature Microbiology "Increased biofilm formation due to high-temperature adaptation in marine Roseobacter" (June 30, 2018) Available at: https://www.ncbi.nlm.nih.gov/pubmed/30061756

[119] McFadden, McGough, Fisman, Santillana, and Browstein. Nature "Antibiotic resistance increases with local temperature" (May 21, 2018) Available at: https://www.nature.com/articles/s41558-018-0161-6

[120] Arturo Casadevall, Dimitrios P. Kontoyiannis, Vincent Robert. American Society for Microbiology. Science Daily "Rise of Candida auris blamed on global warming" (July 23, 2019) Available at: https://www.sciencedaily.com/releases/2019/07/190723085941.htm

[121] Centers for Disease Control "*Antibiotic Resistance Threats in the United States, 2019*" (2019) Available at: https://www.cdc.gov/drugresistance/biggest-threats.html

[122] "Achaogen Plans for Near-Term Sale Using Structured Process Through Chapter 11 of the U.S. Bankruptcy Code " (April 15, 2019) Available at: http://investors.achaogen.com/news-releases/news-release-details/achaogen-plans-near-term-sale-using-structured-process-through

[123] Missakian, Natalie. Hartford Business Journal "New Haven's Melinta eyes bankruptcy filing" (Nov. 18, 2019) Available at: https://www.hartfordbusiness.com/article/new-havens-melinta-eyes-bankruptcy-filing

Supportive Policies to Enable Rapid Response to Emerging Infections and Antimicrobial Resistance Linked to Climate Change

Regulatory Reform and Clarity

Regarding platform technologies, the regulatory uncertainty stemming from FDA's assertion that it does not license platforms raises concerns over a viable rapid deployment pathway for this technology. Congress should direct FDA to issue guidance related to regulatory considerations and pathways for vaccine platforms to ensure there is a swift regulatory process in place for the deployment of this technology once an urgent need arises.

Congress should also help to promote the swift approval and deployment of self-limiting insect technologies currently seeking regulatory approval at EPA. These mosquitoes, whose wild counterparts are vectors for diseases such as Zika, Yellow Fever, and others, are engineered to contain a self-limiting lethal gene. When the engineered mosquito is released and mates with a wild mosquito, that lethal gene is passed on to their offspring, resulting in their elimination. Field trials in Central and South America have demonstrated the ability of curbing wild mosquito populations by over 90 percent.[124]

Funding for R&D, Development Incentive, and Surveillance

Increased resources for disease surveillance and R&D of infectious disease products can help to address these emerging public health challenges related to climate change. Providing sufficient resources for BARDA to conduct advanced R&D for vaccine platform technologies will be a critical step to ensure we are prepared for the increased frequency at which we will face a variety of emerging infectious diseases. By having a better basic understanding the similarities of emerging strains and how platform technologies can be modeled to fit to them, we will be much better prepared to rapidly develop vaccines as needed.

In addition, it is easier to respond to emerging diseases early in an outbreak when a disease is geographically contained. The CDC conducts critical work in surveillance and early detection of outbreaks. BIO recommends that these surveillance networks are sufficiently funded to ensure quick detection.

Regarding AMR, urgent action is needed by the U.S. government to address the unique market challenges of the antimicrobial development, both in terms of stabilizing the pipeline and market as well as developing incentives that drive investment into new antimicrobials. BIO believes a package of incentives, including reforms to address reimbursement challenges for antimicrobials, coupled with a pull incentive that rewards entry to the market for innovative antimicrobials that treat unmet medical needs, will help address these commercial challenges.

[124] Olena, Abby. The Scientist "GM Mosquitoes Closer to Release in U.S." (Oct 13, 2017) Available at: https://www.the-scientist.com/news-analysis/gm-mosquitoes-closer-to-release-in-us-30752

13. The climate crisis requires a global response. U.S. leadership is critical for successful global solutions. What policies should Congress adopt to support international action on the climate crisis?

Overview –Developing Nations – Developing Nations' Need for Technology to Mitigate and Adapt to Climate Impacts

Developing nations around the world will likely be the most affected by climate change, yet have the fewest means to respond to the crisis. At a recent meeting of the United Nations General Assembly, many developing nations expressed frustration that their countries have been disproportionately burdened by climate change, and thus will have a difficult time meeting their U.N. Sustainable Development Goals (UNSDG) as a result.[125] It will be increasingly difficult for nations to vaccinate populations in the face of emerging infectious diseases; avoid wasting water as supplies dry up due to diminished snowpack and aquafers; or achieve zero hunger when droughts, heat, and climate-enabled insect populations devastate crops and livestock.

Many of the technologies discussed in these comments would be of immense benefit not just to Americans, but to global populations struggling to adapt and mitigate their own climate impact. Whether its platform-based vaccines for emerging Ebola strains in West Africa; salinity-tolerant rice allowing for continued rice production in ocean-flooded patties in Southeast Asia; or bio-based compostable products allowing for sustainable consumer goods without fearing ocean pollution, biotechnology has significant promise to heal, fuel, and feed the world if we support it through sound public policies.

Supportive Policies to Enable U.S. Leadership Globally on the Climate Crisis

U.S. Leadership in International Bodies

The United States continues to be an influential leader in numerous global bodies, such as the G-7, G-20, United Nations, World Trade Organization (WTO), and others. For example, the United States helps to lead a group of like-minded nations at the WTO to call for science-based decision making in the use of technology, like gene editing, to solve global challenges.[126] While the evidence presented throughout these comments would make it seem as if this position should be an obvious one based on the promising solutions science and technology have to offer, sadly, this position is not a self-evident position globally. Many nations, preferring to adopt economically protectionist or overly precautionary policies, resist the use

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[125] United Nations "Unprecedented Impacts of Climate Change Disproportionately Burdening Developing Countries, Delegate Stresses, as Second Committee Concludes General Debate" (Oct. 8, 2019) Available at: https://www.un.org/press/en/2019/gaef3516.doc.htm

[126] World Trade Organization "Members discuss precision biotechnology as a tool for agricultural innovation" (Nov. 2018) Available at: https://www.wto.org/english/news_e/news18_e/sps_01nov18_e.htm

of technological solutions, which hinders our ability to equip our global partners – especially those in developing nations, who need help the most – with the tools needed to address the increasingly urgent climate crisis.

Cross-Agency International Strategy

BIO recommends that the U.S. federal government develop a coordinated, cross-agency strategy to advocate for enabling science and technology to deploy climate solutions in these international bodies. Moreover, the United States should continue to foster deeper relationships with like-minded nations in these global bodies to better develop international coalitions similarly interested in using innovation to address climate change.

Conclusion

BIO thanks the Committee for putting forward this RFI and seeking recommendation for innovations, solutions, and policies to achieve substantial and permanent reductions in pollution that contributes to the climate crisis.

Decarbonizing our economy will require numerous innovations. Supporting the development and deployment of biotechnologies will enable the United States to reduce greenhouse gas emissions across transportation, industry, and agriculture.

BIO and its member companies stand at the forefront of the U.S. bioeconomy and we are proud that we have helped to make the United States the global leader in biotechnology innovation. The furthering of biotechnology solutions can help achieve our shared goals of reducing greenhouse gas emissions and developing cleaner and more sustainable energy sources. BIO urges that, as you work toward developing the Committee's legislative and policy initiatives, you give pro-innovation policies and technologies your strongest consideration and seize the opportunity to expand on American leadership in this space.