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REPORT
116–270

ENGINEERING BIOLOGY RESEARCH AND DEVELOPMENT ACT OF 2019

NOVEMBER 5, 2019.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Ms. JOHNSON of Texas, from the Committee on Science, Space, and Technology, submitted the following

R E P O R T

[To accompany H.R. 4373]

[Including cost estimate of the Congressional Budget Office]

The Committee on Science, Space, and Technology, to whom was referred the bill (H.R. 4373) to provide for a coordinated Federal research initiative to ensure continued United States leadership in engineering biology, having considered the same, report favorably thereon with an amendment and recommend that the bill as amended do pass.

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99–006

I. AMENDMENT

The amendment is as follows:

Strike all after the enacting clause and insert the following:

SECTION 1. SHORT TITLE.

This Act may be cited as the "Engineering Biology Research and Development Act of 2019".

SEC. 2. FINDINGS.

The Congress makes the following findings:

(1) Cellular and molecular processes may be used, mimicked, or redesigned to develop new products, processes, and systems that improve societal well-being, strengthen national security, and contribute to the economy.

(2) Engineering biology relies on a workforce with a diverse and unique set of skills combining the biological, physical, chemical, and information sciences and engineering.

(3) Long-term research and development is necessary to create breakthroughs in engineering biology. Such research and development requires government investment as many of the benefits are too distant or uncertain for industry to support alone.

(4) Research is necessary to inform evidence-based governance of engineering biology and to support the growth of the engineering biology industry.

(5) The Federal Government can play an important role by facilitating the development of tools and technologies to further advance engineering biology, including user facilities, by facilitating public-private partnerships, by supporting risk research, and by facilitating the commercial application in the United States of research funded by the Federal Government.

(5) The United States led the development of the science and engineering techniques that created the field of engineering biology, but due to increasing international competition, the United States is at risk of losing its competitive advantage if does not invest the necessary resources and have a national strategy.

(6) A National Engineering Biology Initiative can serve to establish new research directions and technology goals, improve interagency coordination and planning processes, drive technology transfer to the private sector, and help ensure optimal returns on the Federal investment.

SEC. 3. DEFINITIONS.

In this Act:

(1) BIOMANUFACTURING.—The term "biomanufacturing" means the utilization of biological systems to develop new and advance existing products, tools, and processes at commercial scale.

(2) ENGINEERING BIOLOGY.—The term "engineering biology" means the application of engineering design principles and practices to biological systems, including molecular and cellular systems, to advance fundamental understanding of complex natural systems and to enable novel or optimize functions and capabilities.

(3) INITIATIVE.—The term "Initiative" means the National Engineering Biology Research and Development Initiative established under section 4.

(4) OMICS.—The term "omics" refers to the collective technologies used to explore the roles, relationships, and actions of the various types of molecules that make up the cells of an organism.

SEC. 4. NATIONAL ENGINEERING BIOLOGY RESEARCH AND DEVELOPMENT INITIATIVE.

(a) IN GENERAL.—The President, acting through the Office of Science and Technology Policy, shall implement a National Engineering Biology Research and Development Initiative to advance societal well-being, national security, sustainability, and economic productivity and competitiveness through—

(1) advancing areas of research at the intersection of the biological, physical, chemical, and information sciences and engineering to accelerate scientific understanding and technological innovation in engineering biology;

(2) advancing areas of biomanufacturing research to optimize, standardize, scale, and deliver new products and solutions;

(3) supporting social and behavioral sciences and economics research that advances the field of engineering biology and contributes to the development and public understanding of new products, processes, and technologies;

(4) supporting risk research, including under subsection (d);

(5) supporting the development of novel tools and technologies to accelerate scientific understanding and technological innovation in engineering biology;

(6) expanding the number of researchers, educators, and students with engineering biology training, including from traditionally underserved populations;

(7) accelerating the translation and commercialization of engineering biology research and development by the private sector; and

(8) improving the interagency planning and coordination of Federal Government activities related to engineering biology.

(b) INITIATIVE ACTIVITIES.—The activities of the Initiative shall include—

(1) sustained support for engineering biology research and development through—

(A) grants to individual investigators and teams of investigators, including interdisciplinary teams;

(B) projects funded under joint solicitations by a collaboration of no fewer than two agencies participating in the Initiative; and

(C) interdisciplinary research centers that are organized to investigate basic research questions, carry out technology development and demonstration activities, and increase understanding of how to scale up engineering biology processes, including biomanufacturing;

(2) sustained support for databases and related tools, including—

(A) support for curated genomics, epigenomics, and all other relevant omics databases, including plant and microbial databases, that are available to researchers to carry out engineering biology research;

(B) development of standards for such databases, including for curation, interoperability, and protection of privacy and security; and

(C) support for the development of computational tools, including artificial intelligence tools, that can accelerate research and innovation using such databases; and

(D) an inventory and assessment of all Federal government omics databases to identify opportunities for consolidation and inform investment in such databases as critical infrastructure for the engineering biology research enterprise;

(3) sustained support for the development, optimization, and validation of novel tools and technologies to enable the dynamic study of molecular processes in situ, including through grants to investigators at institutions of higher education and other nonprofit research institutions, and through the Small Business Innovation Research Program and the Small Business Technology Transfer Program, as described in section 9 of the Small Business Act (15 U.S.C. 638);

(4) education and training of undergraduate and graduate students in engineering biology, in biomanufacturing, in bioprocess engineering, and in areas of computational science applied to engineering biology;

(5) activities to develop robust mechanisms for tracking and quantifying the outputs and economic benefits of engineering biology; and

(6) activities to accelerate the translation and commercialization of new products, processes, and technologies by—

(A) identifying precompetitive research opportunities;

(B) facilitating public-private partnerships in engineering biology research and development;

(C) connecting researchers, graduate students, and postdoctoral fellows with entrepreneurship education and training opportunities; and

(D) supporting proof of concept activities and the formation of startup companies including through programs such as the Small Business Innovation Research Program and the Small Business Technology Transfer Program.

(c) EXPANDING PARTICIPATION.—The Initiative shall include, to the maximum extent practicable, outreach to primarily undergraduate and minority-serving institutions about Initiative opportunities, and shall encourage the development of research collaborations between research-intensive universities and primarily undergraduate and minority-serving institutions.

(d) ETHICAL, LEGAL, ENVIRONMENTAL, SAFETY, SECURITY, AND SOCIETAL ISSUES.—Initiative activities shall take into account ethical, legal, environmental, safety, security, and other appropriate societal issues by—

(1) supporting research, including in the social sciences, and other activities addressing ethical, legal, environmental, and other appropriate societal issues related to engineering biology, including integrating research on such topics with the research and development in engineering biology, and ensuring that the results of such research are widely disseminated, including through interdisciplinary engineering biology research centers described in subsection (b)(1);

(2) supporting research and other activities related to the safety and security implications of engineering biology, including outreach to increase awareness among federally-funded researchers at institutions of higher education about po-

tential safety and security implications of engineering biology research, as appropriate;

(3) ensuring that input from Federal and non-Federal experts on the ethical, legal, environmental, security, and other appropriate societal issues related to engineering biology is integrated into the Initiative; and

(4) ensuring, through the agencies and departments that participate in the Initiative, that public input and outreach are integrated into the Initiative by the convening of regular and ongoing public discussions through mechanisms such as workshops, consensus conferences, and educational events, as appropriate.

SEC. 5. INITIATIVE COORDINATION.

(a) INTERAGENCY COMMITTEE.—The President, acting through the Office of Science and Technology Policy, shall designate an interagency committee to coordinate engineering biology, which shall be co-chaired by the Office of Science and Technology Policy, and include representatives from the National Science Foundation, the Department of Energy, the National Aeronautics and Space Administration, the National Institute of Standards and Technology, the Environmental Protection Agency, the Department of Agriculture, the National Institutes of Health, the Bureau of Economic Analysis, and any other agency that the President considers appropriate (in this section referred to as the "interagency committee"). The Director of the Office of Science and Technology Policy shall select an additional co-chairperson from among the members of the Interagency Committee. The Interagency Committee shall oversee the planning, management, and coordination of the Initiative. The Interagency Committee shall—

(1) provide for interagency coordination of Federal engineering biology research, development, and other activities undertaken pursuant to the Initiative;

(2) establish and periodically update goals and priorities for the Initiative;

(3) develop, not later than 12 months after the date of enactment of this Act, and update every 3 years, a strategic plan that—

(A) guides the activities of the Initiative for purposes of meeting the goals and priorities established under (and updated pursuant to) paragraph (2); and

(B) describes—

(i) the Initiative's support for long-term funding for interdisciplinary engineering biology research and development;

(ii) the Initiative's support for education and public outreach activities;

(iii) the Initiative's support for research and other activities on ethical, legal, environmental, safety, security, and other appropriate societal issues related to engineering biology;

(iv) how the Initiative will move results out of the laboratory and into application for the benefit of society and United States competitiveness; and

(v) how the Initiative will measure and track the contributions of engineering biology to United States economic growth and other societal indicators;

(4) develop a national genomic sequencing strategy to ensure engineering biology research fully leverages plant, animal, and microbe biodiversity to enhance long-term innovation and competitiveness in engineering biology in the United States;

(5) propose an annually coordinated interagency budget for the Initiative that is intended to ensure—

(A) the maintenance of a robust engineering biology research and development portfolio; and

(B) that the balance of funding across the Initiative is sufficient to meet the goals and priorities established for the Program;

(6) develop a plan to utilize Federal programs, such as the Small Business Innovation Research Program and the Small Business Technology Transfer Program as described in section 9 of the Small Business Act (15 U.S.C. 638), in support of the activities described in section 4(b)(3); and

(7) in carrying out this section, take into consideration the recommendations of the advisory committee established under section 6, the results of the workshop convened under section 7, existing reports on related topics, and the views of academic, State, industry, and other appropriate groups.

(b) ANNUAL REPORT.—Beginning with fiscal year 2020, not later than 90 days after submission of the President's annual budget request and each fiscal year thereafter, the interagency committee shall prepare and submit to the Committee on Science, Space, and Technology of the House of Representatives and the Com-

mittee on Commerce, Science, and Transportation of the Senate a report that includes—

(1) a summarized agency budget in support of the Initiative for the fiscal year to which such budget request applies, and for the then current fiscal year, including a breakout of spending for each agency participating in the Program and for the development and acquisition of any research facilities and instrumentation; and

(2) an assessment of how Federal agencies are implementing the plan described in subsection (a)(3), and a description of the amount and number of awards made under the Small Business Innovation Research Program and the Small Business Technology Transfer Program (as described in section 9 of the Small Business Act (15 U.S.C. 638)) in support of the Initiative.

(c) INITIATIVE STAFFING.—The President shall ensure adequate staffing for the Initiative, including full-time staff within the Office of Science and Technology Policy, who shall—

(1) provide technical and administrative support to the interagency committee and the advisory committee established under section 6;

(2) serve as the point of contact on Federal engineering biology activities for government organizations, academia, industry, professional societies, State governments, interested citizen groups, and others to exchange technical and programmatic information;

(3) oversee interagency coordination of the Initiative, including by encouraging and supporting joint agency solicitation and selection of applications for funding of activities under the Initiative;

(4) conduct public outreach, including dissemination of findings and recommendations of the advisory committee established under section 6, as appropriate; and

(5) promote access to, and early application of, the technologies, innovations, and expertise derived from Initiative activities to agency missions and systems across the Federal Government, and to United States industry, including start-up companies.

SEC. 6. ADVISORY COMMITTEE.

(a) IN GENERAL.—The President, acting through the Office of Science and Technology Policy, shall designate or establish an advisory committee on engineering biology research and development (in this section referred to as the "advisory committee") to be composed of not fewer than 12 members, including representatives of research and academic institutions, industry, and nongovernmental entities, who are qualified to provide advice on the Initiative.

(b) ASSESSMENT.—The advisory committee shall assess—

(1) the current state of United States competitiveness in engineering biology, including the scope and scale of United States investments in engineering biology research and development in the international context;

(2) current market barriers to commercialization of engineering biology products, processes, and tools in the United States;

(3) progress made in implementing the Initiative;

(4) the need to revise the Initiative;

(5) the balance of activities and funding across the Initiative;

(6) whether the strategic plan developed or updated by the interagency committee established under section 5 is helping to maintain United States leadership in engineering biology;

(7) the management, coordination, implementation, and activities of the Initiative; and

(8) whether ethical, legal, environmental, safety, security, and other appropriate societal issues are adequately addressed by the Initiative.

(c) REPORTS.—Beginning not later than 2 years after the date of enactment of this Act, and not less frequently than once every 3 years thereafter, the advisory committee shall submit to the President, the Committee on Science, Space, and Technology of the House of Representatives, and the Committee on Commerce, Science, and Transportation of the Senate, a report on—

(1) the findings of the advisory committee's assessment under subsection (b); and

(2) the advisory committee's recommendations for ways to improve the Initiative.

(d) APPLICATION OF FEDERAL ADVISORY COMMITTEE ACT.—Section 14 of the Federal Advisory Committee Act (5 U.S.C. App.) shall not apply to the Advisory Committee.

SEC. 7. EXTERNAL REVIEW OF ETHICAL, LEGAL, ENVIRONMENTAL, AND SOCIETAL ISSUES.

(a) IN GENERAL.—Not later than 6 months after the date of enactment of this Act, the Director of the National Science Foundation shall enter into an agreement with the National Academies of Sciences, Engineering, and Medicine to conduct a review, and make recommendations with respect to, the ethical, legal, environmental, and other appropriate societal issues related to engineering biology research and development. The review shall include—

(1) an assessment of the current research on such issues;

(2) a description of the research gaps relating to such issues;

(3) recommendations on how the Initiative can address the research needs identified pursuant to paragraph (2); and

(4) recommendations on how engineering biology researchers can best incorporate considerations of ethical, legal, environmental, and other societal issues into the development of research proposals and the conduct of research.

(b) REPORT TO CONGRESS.—The agreement entered into under subsection (a) shall require the National Academy of Sciences, Engineering, and Medicine to, not later than 2 years after the date of the enactment of this Act—

(1) submit to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate a report containing the findings and recommendations of the review conducted under subsection (a); and

(2) make a copy of such report available on a publicly accessible website.

SEC. 8. AGENCY ACTIVITIES.

(a) NATIONAL SCIENCE FOUNDATION.—As part of the Initiative, the National Science Foundation shall—

(1) support basic research in engineering biology through individual grants and through interdisciplinary research centers;

(2) support research on the environmental, legal, and social implications of engineering biology;

(3) provide support for research instrumentation for engineering biology disciplines, including support for research, development, optimization and validation of novel technologies to enable the dynamic study of molecular processes in situ;

(4) support curriculum development and research experiences for secondary, undergraduate, and graduate students in engineering biology and biomanufacturing; and

(5) award grants, on a competitive basis, to enable institutions to support graduate students and postdoctoral fellows who perform some of their engineering biology research in an industry setting.

(b) DEPARTMENT OF COMMERCE.—As part of the Initiative, the Director of the National Institute of Standards and Technology shall—

(1) establish a bioscience research program to advance the development of standard reference materials and measurements and to create new data tools, techniques, and processes necessary to advance engineering biology and biomanufacturing;

(2) provide access to user facilities with advanced or unique equipment, services, materials, and other resources to industry, institutions of higher education, nonprofit organizations, and government agencies to perform research and testing; and

(3) provide technical expertise to inform the potential development of guidelines or safeguards for new products, processes, and systems of engineering biology.

(c) DEPARTMENT OF ENERGY.—As part of the Initiative, the Secretary of Energy shall—

(1) conduct and support research, development, demonstration, and commercial application activities in engineering biology, including in the areas of synthetic biology, advanced biofuel development, biobased materials, and environmental remediation;

(2) support the development, optimization and validation of novel, scalable tools and technologies to enable the dynamic study of molecular processes in situ; and

(3) provide access to user facilities with advanced or unique equipment, services, materials, and other resources, as appropriate, to industry, institutions of higher education, nonprofit organizations, and government agencies to perform research and testing.

(d) NATIONAL AERONAUTICS AND SPACE ADMINISTRATION.—As part of the Initiative, the National Aeronautics and Space Administration shall—

(1) conduct and support basic and applied research in engineering biology, including in synthetic biology, and related to Earth and space sciences, aeronautics, space technology, and space exploration and experimentation, consistent with the priorities established in the National Academies' decadal surveys; and

(2) award grants, on a competitive basis, that enable institutions to support graduate students and postdoctoral fellows who perform some of their engineering biology research in an industry setting.

(e) ENVIRONMENTAL PROTECTION AGENCY.—As part of the Initiative, the Environmental Protection Agency shall support research on how products, processes, and systems of engineering biology will affect or can protect the environment.

II. PURPOSE OF THE BILL

The purpose of the bill is to provide for a coordinated Federal research initiative to ensure continued United States leadership in engineering biology.

III. BACKGROUND AND NEED FOR THE LEGISLATION

Engineering biology research applies engineering design principles and practices to biological systems such as molecular, cellular, and microbial systems, to advance fundamental understanding of complex natural systems and enable novel functions and capabilities. Engineering biology has the potential to address some of the most serious societal challenges, including providing food for a growing population, reducing our dependency on fossil fuels, protecting our environment, and improving human health. It will also drive our economy in the 21st century. U.S. revenues from engineered biological systems reached at least $388 billion in 2017, or 2 percent of GDP.

Other countries are making significant progress in engineering biology. China, in particular, has made it a priority to be the global leader in engineering biology and is investing accordingly. In 2018, a Chinese official publicly reported that the bioeconomy in China is growing at 15 percent annually and in 2015 generated $700 billion, or approximately 4 percent of GDP, with a government target to more than double this to $1.6 trillion by 2020. The European Union has also prioritized engineering biology research.

While the Administration, at the time of the filing of this legislative report, is taking steps toward the creation of a national bioeconomy initiative with a focus on Federal investments in engineering biology R&D, there is currently no formal mechanism for a coordinated federal government approach to investments in this field or to partnership with the private sector. Furthermore, the legislation ensures full transparency to the Congress and the public in the development of a federal research agenda and the process by which the agencies seek expert input from outside stakeholders. Finally, through its emphasis on societal implications, including ethics, safety, and security, this legislation ensures that the goal of U.S. economic leadership in the bioeconomy does not overtake the goal of ensuring responsible leadership that protects the public, including our most vulnerable populations, the environment, and our national security, and takes into account societal values.

H.R. 4373 creates the foundation for U.S. leadership in the bioeconomy while also ensuring that the U.S. is positioned to lead global discussions about safety, security, ethics, and other governance issues related to engineering biology.

IV. Committee Hearings

On March 12, 2019, the Subcommittee on Research and Technology of the Committee on Science, Space, and Technology held a hearing to review the opportunities and challenges with new and emerging bioscience and biotechnologies with application in agriculture, energy, and manufacturing; to examine the role of the federal government in research and development (R&D) and oversight of such science and technologies; and to examine the status of U.S. leadership in engineering biology. An additional purpose of this hearing was to receive testimony on the *Engineering Biology Research and Development Act*.

The Subcommittee heard testimony from five witnesses: Dr. Rob Carlson, Managing Director of Bioeconomy Capital; Dr. Kevin Solomon, Assistant Professor of Agricultural & Biological Engineering at Purdue University; Dr. Eric Hegg, Professor of Biochemistry and Molecular Biology, Michigan State University and Michigan State University Subcontract Lead, Great Lakes Bioenergy Research Center; Dr. Sean Simpson, Chief Scientific Officer and Co-Founder of LanzaTech; and Dr. Laurie Zoloth, Margaret E. Burton Professor of Religion and Ethics, and Senior Advisor to the Provost for Programs in Social Ethics at the University of Chicago.

V. Committee Consideration and Votes

On September 18, 2019, Chairwoman Eddie Bernice Johnson, joined by Ranking Member Frank Lucas, Rep. Zoe Lofgren (D–CA) and Rep. James Sensenbrenner (R–WI) introduced H.R. 4373, the *Engineering Biology Research and Development Act of 2019*. The bill was referred to the House Committee on Science, Space, and Technology.

On September 25, 2019, the Committee on Science, Space, and Technology met to consider H.R. 4373. Ms. Johnson offered an amendment to make technical corrections; to add curriculum development for secondary education in engineering biology to the list of activities to be supported by the National Science Foundation; and to updated the required study by the National Academies to include recommendations for researchers on how best to incorporate consideration of ethical and other societal issues into the design and conduct of their research. *The amendment was agreed to on a voice vote*. Ms. Johnson moved that the Committee favorably report the bill, H.R. 4373, to the House with the recommendation that the bill be approved. *The motion was agreed to by a voice vote*.

VI. Summary of Major Provisions of the Bill

H.R. 4374 would establish a federal engineering biology research initiative and require a national strategy for federal agency investments and a framework for interagency coordination. The legislation would also expand public-private partnerships and expand education and training for the next generation of engineering biology researchers. Further, it provides direction for mission-relevant activities in engineering biology for several agencies, including the National Science Foundation, the Department of Energy, the National Institute of Standards and Technology, the Environmental Protection Agency and the National Aeronautics and Space Administration. Finally, the legislation ensures that the authorized Initia-

tive would address potential ethical, legal, environmental, safety and security issues associated with engineering biology research.

VII. Section-by-Section Analysis (By Title and Section)

Section 1. Short title

Engineering Biology Research and Development Act of 2019.

Section 2. Findings

Highlights the importance of engineering biology to societal well-being, national security, and the economy, and how the federal government can play an important role in maintaining U.S. leadership in engineering biology research and development.

Section 3. Definitions

Defines terms used in the bill.

Section 4. National Engineering Biology Research and Development Initiative

Subsection (a) establishes a National Engineering Biology Research and Development Initiative to advance engineering biology research; support risk research to address ethical, safety, security and other societal implications of engineering biology; support the development of tools to accelerate engineering biology research; expand the number of engineering biology researchers; accelerate the translation and commercialization of engineering biology research; and improve interagency planning and coordination of federal engineering biology research initiatives.

Subsection (b) describes the specific activities of the Initiative, including support for research grants, research centers, "omics" databases, novels tools and technologies to accelerate research, education and training of students, metrics to understand and assess the bioeconomy, and technology transfer activities.

Subsection (c) requires outreach to minority-serving institutions and predominantly undergraduate institutions and encourages research collaborations among different types of institutions.

Subsection (d) describes how the Initiative should take into account the ethical, legal, environmental, safety, security, and other appropriate societal concerns.

Sec. 5. Initiative coordination

Requires OSTP to designate an Interagency Committee that would oversee the planning, management, and coordination of the Initiative, in addition to developing and regularly updating a strategic plan for the Initiative, developing a national genomic sequencing strategy; and submitting to Congress an annual coordinated interagency budget proposal for the Initiative.

Section 6. Advisory Committee

Designates an Advisory Committee of non-Federal members to provide advice on the Initiative (in practice the intent would be for PCAST to fill this role); charges the Committee with specific duties; and requires the Committee to report on their findings and recommendations at least every 3 years.

Section 7. External review of ethical, environmental, and societal concerns

Requires a National Academy of Sciences workshop to review the ethical, environmental, societal, and health concerns related to engineering biology research and development.

Section 8. Agency functions

Describes specific Initiative activities and responsibilities for the National Science Foundation, the National Institute of Standards and Technology, the Department of Energy, the National Aeronautics and Space Administration, and the Environmental Protection Agency.

VIII. Committee Views

It is the intent of the Committee that the Director of the Office of Science and Technology Policy collaborate and coordinate with security and intelligence agencies as needed to address any emerging security concerns with respect to engineering biology. This may include appointing representatives of such agencies to the interagency committee required under Section 5. Similarly, the Committee believes that more data and analyses of the bioeconomy will be an important tool in informing both the Federal research agenda and private sector investments. As such, we encourage the Department of Commerce's Bureau of Economic Analysis to participate in the Initiative IWG and to develop and publish new metrics for the bioeconomy.

Further, while the Committee accepted OSTP's request not to establish a formal coordination office in the Act, it is the intent of the Committee that the OSTP Director appoint such staff as are necessary to carry out all of the responsibilities described in Section 5(c), including through the recruitment of additional agency detailees with relevant expertise.

Section 7 requires a National Academies review of ethical, legal, environmental and other societal implications of engineering biology research and development. While the Committee has great respect for the Academies and its established process for appointing study committees, we encourage the Academies staff to cast a sufficiently broad net in seeking experts from both academia and the private-sector to reflect the diversity that exists within engineering biology, including the diversity in potential products, economic sectors, technology areas, and research directions.

IX. Cost Estimate

Pursuant to clause 3(c)(2) of rule XIII of the Rules of the House of Representatives, the Committee adopts as its own the estimate of new budget authority, entitlement authority, or tax expenditures or revenues contained in the cost estimate prepared by the Director of the Congressional Budget Office pursuant to section 402 of the Congressional Budget Act of 1974.

X. Congressional Budget Office Cost Estimate

U.S. Congress,
Congressional Budget Office,
Washington, DC, November 1, 2019.

Hon. Eddie Bernice Johnson,
Chairwoman, Committee on Science, Space, and Technology,
House of Representatives, Washington, DC.

Dear Madam Chairwoman: The Congressional Budget Office has prepared the enclosed cost estimate for H.R. 4373, the Engineering Biology Research and Development Act of 2019.

If you wish further details on this estimate, we will be pleased to provide them. The CBO staff contact is Janani Shankaran.

Sincerely,

Phillip L. Swagel,
Director.

Enclosure.

H.R. 4373, Engineering Biology Research and Development Act of 2019
As ordered reported by the House Committee on Science, Space, and Technology on September 25, 2019

By Fiscal Year, Millions of Dollars	2020	2020-2024	2020-2029
Direct Spending (Outlays)	0	0	0
Revenues	0	0	0
Increase or Decrease (-) in the Deficit	0	0	0
Spending Subject to Appropriation (Outlays)	1	7	not estimated

		Mandate Effects	
Statutory pay-as-you-go procedures apply?	No		
Increases on-budget deficits in any of the four consecutive 10-year periods beginning in 2030?	No	Contains intergovernmental mandate?	No
		Contains private-sector mandate?	No

H.R. 4373 would direct the Office of Science and Technology Policy (OSTP) to establish a national engineering biology research and development initiative. Under that initiative, federal agencies would provide research grants in engineering biology, develop and validate tools and technologies, support the commercialization of engineering biology products, and conduct related public outreach. The bill would require OSTP to establish an interagency committee—with representation from at least eight federal agencies—to coordinate those activities. H.R. 4373 also would direct the National Science Foundation (NSF) to enter into an agreement with the National Academies to review ethical, legal, environmental, and societal issues related to engineering biology.

Using information from the affected agencies, CBO expects that many agencies are already conducting activities required under the bill. On that basis, and considering the costs of similar tasks, CBO estimates that each of the eight agencies and OSTP would require one additional employee at an average annual cost of $150,000 each to participate in the initiative and interagency committee. In addition, using information from the NSF, CBO estimates that conducting the required review would cost less than $1 million. In

total, CBO estimates that implementing H.R. 4373 would cost $7 million over the 2020–2024 period; such spending would be subject to the availability of appropriated funds.

The CBO staff contact for this estimate is Janani Shankaran. The estimate was reviewed by H. Samuel Papenfuss, Deputy Assistant Director for Budget Analysis.

XI. Federal Mandates Statement

H.R. 4373 contains no unfunded mandates.

XII. Committee Oversight Findings and Recommendations

The Committee's oversight findings and recommendations are reflected in the body of this report.

XIII. Statement on General Performance Goals and Objectives

H.R. 4373 should result in a more focused and coordinated Federal effort in the conduct of engineering biology research and development with the goal of maintaining U.S. leadership in this field.

XIV. Federal Advisory Committee Statement

The functions of the advisory committee authorized in H.R. 4373 are not currently being performed by one or more agencies. H.R. 4373 permits the President to carry out this requirement by enlarging the mandate of an existing advisory committee.

XV. Duplication of Federal Programs

Pursuant to clause 3(c)(5) of rule XIII of the Rules of the House of Representatives, the Committee finds that no provision of H.R. 4373 establishes or reauthorizes a program of the federal government known to be duplicative of another federal program, including any program that was included in a report to Congress pursuant to section 21 of Public Law 111–139 or the most recent Catalog of Federal Domestic Assistance.

XVI. Earmark Identification

Pursuant to clause 9(e), 9(f), and 9(g) of rule XXI, the Committee finds that H.R. 4373 contains no earmarks, limited tax benefits, or limited tariff benefits.

XVII. Applicability to the Legislative Branch

The Committee finds that H.R. 4373 does not relate to the terms and conditions of employment or access to public services or accommodations within the meaning of section 102(b)(3) of the Congressional Accountability Act (Public Law 104–1).

XVIII. Statement on Preemption of State, Local, or Tribal Law

This bill is not intended to preempt any state, local, or tribal law.

XIX. Changes in Existing Law Made by the Bill, as Reported

This legislation does not amend any existing Federal statute.

XX. Proceedings of the Full Committee Markup

MARKUPS: H.R. 4373, THE ENGINEERING BIOLOGY RESEARCH AND DEVELOPMENT ACT OF 2019; H.R. 4372, THE MSI STEM ACHIEVEMENT ACT; AND H.R. 4355, THE IDENTIFYING OUTPUTS OF GENERATIVE ADVERSARIAL NETWORKS ACT

MARKUP

BEFORE THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

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FIRST SESSION

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MARKUPS: H.R. 4373, THE ENGINEERING BIOLOGY RESEARCH AND DEVELOPMENT ACT OF 2019; H.R. 4372, THE MSI STEM ACHIEVEMENT ACT; AND H.R. 4355, THE IDENTIFYING OUTPUTS OF GENERATIVE ADVERSARIAL NETWORKS ACT

WEDNESDAY, SEPTEMBER 25, 2019

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Committee met, pursuant to notice, at 10:01 a.m., in room 2318 of the Rayburn House Office Building, Hon. Eddie Bernice Johnson [Chairwoman of the Committee] presiding.

Chairwoman JOHNSON. Good morning. The Committee will come to order. And without objection, the Chair is authorized to declare recess at any time. Pursuant to Committee rule 2(e) and House rule XI, the Chair announces that she may postpone roll call votes.

Pursuant to notice, the Committee meets to consider the following measures: H.R. 4373, the *Engineering Biology Research and Development Act of 2019*; H.R. 4372, the *MSI STEM Achievement Act*; and H.R. 4355, *Identifying Outputs of Generative Adversarial Networks Act*.

Welcome to today's Science Committee markup of these three bipartisan bills. First, we will consider H.R. 4373, the *Engineering Biology Research and Development Act of 2019*.

Engineering biology has the potential to address some of the most serious challenges facing our Nation, from food production to environmental cleanup, to clean energy, and of course health care. It will also drive our economy in the 21st century. U.S. revenues from engineered biological systems reached at least $388 billion in 2017. H.R. 4373 creates the foundation for U.S. leadership in the bioeconomy while also ensuring that the United States is positioned to lead global discussions about responsible development and governance of engineering biology.

H.R. 4373 would establish a Federal engineering biology research initiative and require a national strategy for our investments and a framework for interagency coordination. The legislation would also expand public-private partnerships and expand education and training for the next generation of engineering biology researchers. It authorizes mission-relevant activities for several agencies within the jurisdiction of this Committee. Finally, throughout the legisla-

tion, we ensure that the initiative would address potential ethical, legal, environmental, safety, and security issues associated with engineering biology research.

Next, we will consider H.R. 4372, the *MSI STEM Achievement Act*. Our Nation's underrepresented minority students have long been an underutilized resource for STEM (science, technology, engineering, and mathematics) talent. For our country to remain competitive in the 21st century, this situation must change. Fortunately, America's minority-serving institutions (MSIs) have been working for decades to prepare underrepresented minority students to enter STEM fields. Our MSIs have helped advance participation in STEM fields by developing tried-and-true models for inclusive curriculum, effective student mentoring, and fostering a welcoming campus climate.

The *MSI STEM Achievement Act* provides for increased transparency, accountability, and accessibility of Federal STEM education and research funding for the MSIs. The bill directs the Government Accountability Office to compile an inventory of Federal science agency programs targeted to MSIs and to make recommendations for steps agencies can take to encourage increased participation and success for the MSIs in these programs.

The National Science Foundation is authorized to support research on the challenges and successes MSIs have had—in contributing to the STEM workforce, including approaches to build research competitiveness for them.

Finally, the bill directs the Office of Science and Technology Policy to develop a governmentwide strategic plan and sustained outreach program to support STEM education and research at the MSIs.

The last bill we consider today is H.R. 4355, the *Identifying Outputs of Generative Adversarial Networks Act*. This very technical topic is more commonly known as "deep fakes." The National Science Foundation (NSF) and the National Institute of Standards and Technology (NIST) both have critical roles to play in the research and standards development to counter the spread and consequences of deep fakes. Importantly, this legislation also emphasizes public-private partnerships in this area.

I want to thank Mr. Gonzalez and his bipartisan cosponsors for introducing this good bill, and I urge my colleagues to support it. I think these are all good bills, and I look forward to a productive markup today.

[The prepared statement of Chairwoman Johnson follows:]

Welcome to today's Science Committee markup of three bipartisan bills.

First we will consider H.R. 4373, the *Engineering Biology Research and Development Act of 2019*. Engineering biology has the potential to address some of the most serious challenges facing our nation, from food production to environmental cleanup, to clean energy, and of course healthcare. It will also drive our economy in the 21st century. U.S. revenues from engineered biological systems reached at least $388 billion in 2017.

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I think these are all good bills, and I look forward to a productive markup today.

Chairwoman JOHNSON. I now recognize our Ranking Member, Mr. Lucas, for his opening remarks.

Mr. LUCAS. Thank you, Chairwoman Johnson, for holding this markup.

Today, we'll consider three bipartisan bills. The first is H.R. 4373, the *Engineering Biology Research and Development Act of 2019*. I'm proud to join Chairwoman Johnson, as well as Representatives Jim Sensenbrenner and Zoe Lofgren, in introducing this bill. H.R. 4373 promotes a national research strategy around engineering biology to ensure that the U.S. remains the global leader in biology and biotechnology. I will speak further on this bill when it's brought up for consideration in a moment.

Our second bill this morning is H.R. 4372, the *MSI STEM Achievement Act*, sponsored by Chairwoman Johnson and Representative Michael Waltz. The bill continues our Committee's bipartisan work to support, encourage, and develop the next generation of STEM students.

Minority-serving institutions, including historically black colleges and universities, Hispanic-serving institutions, and tribal colleges and universities, have a long record of success in recruiting, training, and graduating underrepresented students in STEM fields.

In my own district, I have seen the unique value of minority-serving institutions. For more than 100 years, Langston University, a historically black college and land-grant institution, has educated students of all backgrounds and influenced people's lives beyond the boundaries of the classroom in service to the community in both rural and urban Oklahoma. This legislation will help schools like Langston prepare their students to fill the STEM jobs of the

21st century. I want to thank the Chairwoman and Mr. Waltz for their work on this legislation and urge my colleagues to support it.

Finally, we'll consider H.R. 4355, the *Identifying Outputs of Generative Adversarial Networks Act*, introduced by Representative Anthony Gonzalez. Generative adversarial networks (GANs) use machine learning to manipulate videos and other digital content to produce misleading and false products, commonly known as deep fakes. These technologies are becoming more sophisticated, and, in the wrong hands, they present a serious security threat. Bad actors already seek to use disinformation to disrupt civil society and sow division among Americans.

This bill supports the fundamental research necessary to better understand the underlying technology, to develop tools to identify manipulated content, and to better understand how humans interact with this generated content. The bill also tasks NIST with bringing together the private sector and government agencies to discuss how to responsibly advance innovation in this area.

I applaud Mr. Gonzalez's bipartisan work on this bill, and his leadership on the issue of technology and security. I appreciate his staff working with Committee staff on both sides of the aisle to address technical feedback from the agencies in an amendment that we'll take up later.

Finally, I want to thank the Chairwoman and her staff for working in a bipartisan and collaborative fashion on these three bills. Today's markup demonstrates what we can accomplish in this Committee when we work together on our shared priority of maintaining American leadership in science and technology.

And with that, Madam Chair, I yield back.

[The prepared statement of Mr. Lucas follows:]

Thank you, Chairwoman Johnson, for holding this mark-up.

Today we will consider three bipartisan bills.

The first is H.R. 4373, the *Engineering Biology Research and Development Act of 2019.*

I was proud to join Chairwoman Johnson as well as Representatives Jim Sensenbrenner and Zoe Lofgren in introducing this bill. H.R. 4373 promotes a national research strategy around engineering biology, to ensure the U.S. remains the global leader in biology and biotechnology.

I will speak further on the bill when it is brought up for consideration in a moment.

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Minority serving institutions- including Historically Black Colleges and Universities, Hispanic Serving Institutions, and Tribal Colleges and Universities - have a long record of success in recruiting, retaining and graduating underrepresented students in STEM fields.

In my own district, I have seen the unique value of minority serving institutions. For more than 100 years, Langston University, a historically black college and a land-grant institution, has educated students of all backgrounds, and influenced people's lives beyond the boundaries of the classroom in service to the community in both rural and urban Oklahoma.

This legislation will help schools like Langston prepare their students to fill the STEM jobs of the 21st Century.

I want to thank the Chairwoman and Mr. Waltz for their work on this legislation and urge my colleagues to support it.

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I appreciate his staff working with Committee staff on both sides of the aisle to address technical feedback from the agencies in an Amendment that we will take up later.

Finally, I want to thank the Chairwoman and her staff for working in a bipartisan and collaborative fashion on these three bills.

Today's mark-up demonstrates what we can accomplish in this Committee when we work together on our shared priority of maintaining American leadership in science and technology.

I yield back.

Chairwoman JOHNSON. Thank you very much.

H.R. 4373

Chairwoman JOHNSON. We now will consider H.R. 4373, the *Engineering Biology Research and Development Act of 2019*. The clerk will report the bill.

The CLERK. H.R. 4373, a bill.

[The bill follows:]

.....

(Original Signature of Member)

116TH CONGRESS
1ST SESSION

H. R. _____

To provide for a coordinated Federal research initiative to ensure continued United States leadership in engineering biology.

IN THE HOUSE OF REPRESENTATIVES

Ms. JOHNSON of Texas introduced the following bill; which was referred to the Committee on _____

A BILL

To provide for a coordinated Federal research initiative to ensure continued United States leadership in engineering biology.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Engineering Biology Research and Development Act of 2019".

SEC. 2. FINDINGS.

The Congress makes the following findings:

1 (1) Cellular and molecular processes may be
2 used, mimicked, or redesigned to develop new prod-
3 ucts, processes, and systems that improve societal
4 well-being, strengthen national security, and con-
5 tribute to the economy.
6 (2) Engineering biology relies on a workforce
7 with a diverse and unique set of skills combining the
8 biological, physical, chemical, and information
9 sciences and engineering.
10 (3) Long-term research and development is nec-
11 essary to create breakthroughs in engineering biol-
12 ogy. Such research and development requires govern-
13 ment investment as many of the benefits are too dis-
14 tant or uncertain for industry to support alone.
15 (4) Research is necessary to inform evidence-
16 based governance of engineering biology and to sup-
17 port the growth of the engineering biology industry.
18 (5) The Federal Government can play an im-
19 portant role by facilitating the development of tools
20 and technologies to further advance engineering biol-
21 ogy, including user facilities, by facilitating public-
22 private partnerships, by supporting risk research,
23 and by facilitating the commercial application in the
24 United States of research funded by the Federal
25 Government.

1 (5) The United States led the development of
2 the science and engineering techniques that created
3 the field of engineering biology, but due to increas-
4 ing international competition, the United States is
5 at risk of losing its competitive advantage if does not
6 invest the necessary resources and have a national
7 strategy.
8 (6) A National Engineering Biology Initiative
9 can serve to establish new research directions and
10 technology goals, improve interagency coordination
11 and planning processes, drive technology transfer to
12 the private sector, and help ensure optimal returns
13 on the Federal investment.
14 **SEC. 3. DEFINITIONS.**
15 In this Act:
16 (1) BIOMANUFACTURING.—The term "bio-
17 manufacturing" means the utilization of biological
18 systems to develop new and advance existing prod-
19 ucts, tools, and processes at commercial scale.
20 (2) ENGINEERING BIOLOGY.—The term "engi-
21 neering biology" means the application of engineer-
22 ing design principles and practices to biological sys-
23 tems, including molecular and cellular systems, to
24 advance fundamental understanding of complex nat-

1 ural systems and to enable novel functions and capa-
2 bilities.
3 (3) INITIATIVE.—The term "Initiative" means
4 the National Engineering Biology Research and De-
5 velopment Initiative established under section 4.
6 (4) OMICS.—The term "omics" refers to the
7 collective technologies used to explore the roles, rela-
8 tionships, and actions of the various types of mol-
9 ecules that make up the cells of an organism.

10 **SEC. 4. NATIONAL ENGINEERING BIOLOGY RESEARCH AND**
11 **DEVELOPMENT INITIATIVE.**

12 (a) IN GENERAL.—The President, acting through the
13 Office of Science and Technology Policy, shall implement
14 a National Engineering Biology Research and Develop-
15 ment Initiative to advance societal well-being, national se-
16 curity, sustainability, and economic productivity and com-
17 petitiveness through—
18 (1) advancing areas of research at the intersec-
19 tion of the biological, physical, chemical, and infor-
20 mation sciences and engineering to accelerate sci-
21 entific understanding and technological innovation in
22 engineering biology;
23 (2) advancing areas of biomanufacturing re-
24 search to optimize, standardize, scale, and deliver
25 new products and solutions;

1 (3) supporting social and behavioral sciences
2 and economics research that advances the field of
3 engineering biology and contributes to the develop-
4 ment and public understanding of new products,
5 processes, and technologies;
6 (4) supporting risk research, including under
7 subsection (d);
8 (5) supporting the development of novel tools
9 and technologies to accelerate scientific under-
10 standing and technological innovation in engineering
11 biology;
12 (6) expanding the number of researchers, edu-
13 cators, and students with engineering biology train-
14 ing, including from traditionally underserved popu-
15 lations;
16 (7) accelerating the translation and commer-
17 cialization of engineering biology research and devel-
18 opment by the private sector; and
19 (8) improving the interagency planning and co-
20 ordination of Federal Government activities related
21 to engineering biology.
22 (b) INITIATIVE ACTIVITIES.—The activities of the
23 Initiative shall include—
24 (1) sustained support for engineering biology
25 research and development through—

1 (A) grants to individual investigators and
2 teams of investigators, including interdiscipli-
3 nary teams;
4 (B) projects funded under joint solicita-
5 tions by a collaboration of no fewer than two
6 agencies participating in the Initiative; and
7 (C) interdisciplinary research centers that
8 are organized to investigate basic research
9 questions, carry out technology development
10 and demonstration activities, and increase un-
11 derstanding of how to scale up engineering biol-
12 ogy processes, including biomanufacturing;
13 (2) sustained support for databases and related
14 tools, including—
15 (A) support for curated genomics,
16 epigenomics, and all other relevant omics data-
17 bases, including plant and microbial databases,
18 that are available to researchers to carry out
19 engineering biology research;
20 (B) development of standards for such
21 databases, including for curation, interoper-
22 ability, and protection of privacy and security;
23 and
24 (C) support for the development of com-
25 putational tools, including artificial intelligence

1 tools, that can accelerate research and innova-
2 tion using such databases; and
3 (D) an inventory and assessment of all
4 Federal government omics databases to identify
5 opportunities for consolidation and inform in-
6 vestment in such databases as critical infra-
7 structure for the engineering biology research
8 enterprise;
9 (3) sustained support for the development, opti-
10 mization, and validation of novel tools and tech-
11 nologies to enable the dynamic study of molecular
12 processes in situ, including through grants to inves-
13 tigators at institutions of higher education and other
14 nonprofit research institutions, and through the
15 Small Business Innovation Research Program and
16 the Small Business Technology Transfer Program,
17 as described in section 9 of the Small Business Act
18 (15 U.S.C. 638);
19 (4) education and training of undergraduate
20 and graduate students in engineering biology, in bio-
21 manufacturing, in bioprocess engineering, and in
22 areas of computational science applied to engineer-
23 ing biology;

1 (5) activities to develop robust mechanisms for
2 tracking and quantifying the outputs and economic
3 benefits of engineering biology; and
4 (6) activities to accelerate the translation and
5 commercialization of new products, processes, and
6 technologies by—
7 (A) identifying precompetitive research op-
8 portunities;
9 (B) facilitating public-private partnerships
10 in engineering biology research and develop-
11 ment;
12 (C) connecting researchers, graduate stu-
13 dents, and postdoctoral fellows with entrepre-
14 neurship education and training opportunities;
15 and
16 (D) supporting proof of concept activities
17 and the formation of startup companies includ-
18 ing through programs such as the Small Busi-
19 ness Innovation Research Program and the
20 Small Business Technology Transfer Program.
21 (c) EXPANDING PARTICIPATION.—The Initiative
22 shall include, to the maximum extent practicable, outreach
23 to primarily undergraduate and minority-serving institu-
24 tions about Initiative opportunities, and shall encourage
25 the development of research collaborations between re-

1 search-intensive universities and primarily undergraduate
2 and minority-serving institutions.
3 (d) ETHICAL, LEGAL, ENVIRONMENTAL, SAFETY,
4 SECURITY, AND SOCIETAL ISSUES.—Initiative activities
5 shall take into account ethical, legal, environmental, safe-
6 ty, security, and other appropriate societal issues by—
7 (1) supporting research, including in the social
8 sciences, and other activities addressing ethical,
9 legal, environmental, and other appropriate societal
10 issues related to engineering biology, including inte-
11 grating research on such topics with the research
12 and development in engineering biology, and ensur-
13 ing that the results of such research are widely dis-
14 seminated, including through interdisciplinary engi-
15 neering biology research centers described in sub-
16 section (b)(1);
17 (2) supporting research and other activities re-
18 lated to the safety and security implications of engi-
19 neering biology, including outreach to increase
20 awareness among federally-funded researchers at in-
21 stitutions of higher education about potential safety
22 and security implications of engineering biology re-
23 search, as appropriate;
24 (3) ensuring that input from Federal and non-
25 Federal experts on the ethical, legal, environmental,

1 security, and other appropriate societal issues re-
2 lated to engineering biology is integrated into the
3 Initiative; and
4 (4) ensuring, through the agencies and depart-
5 ments that participate in the Initiative, that public
6 input and outreach are integrated into the Initiative
7 by the convening of regular and ongoing public dis-
8 cussions through mechanisms such as workshops,
9 consensus conferences, and educational events, as
10 appropriate.

11 **SEC. 5. INITIATIVE COORDINATION.**

12 (a) INTERAGENCY COMMITTEE.—The President, act-
13 ing through the Office of Science and Technology Policy,
14 shall designate an interagency committee to coordinate en-
15 gineering biology, which shall be co-chaired by the Office
16 of Science and Technology Policy, and include representa-
17 tives from the National Science Foundation, the Depart-
18 ment of Energy, the National Aeronautics and Space Ad-
19 ministration, the National Institute of Standards and
20 Technology, the Environmental Protection Agency, the
21 Department of Agriculture, the National Institutes of
22 Health, the Bureau of Economic Analysis, and any other
23 agency that the President considers appropriate (in this
24 section referred to as the "interagency committee"). The
25 Director of the Office of Science and Technology Policy

1 shall select an additional co-chairperson from among the
2 members of the Interagency Committee. The Interagency
3 Committee shall oversee the planning, management, and
4 coordination of the Initiative. The Interagency Committee
5 shall—
6 (1) provide for interagency coordination of Fed-
7 eral engineering biology research, development, and
8 other activities undertaken pursuant to the Initia-
9 tive;
10 (2) establish and periodically update goals and
11 priorities for the Initiative;
12 (3) develop, not later than 12 months after the
13 date of enactment of this Act, and update every 3
14 years, a strategic plan that—
15 (A) guides the activities of the Initiative
16 for purposes of meeting the goals and priorities
17 established under (and updated pursuant to)
18 paragraph (2); and
19 (B) describes—
20 (i) the Initiative's support for long-
21 term funding for interdisciplinary engineer-
22 ing biology research and development;
23 (ii) the Initiative's support for edu-
24 cation and public outreach activities;

1 (iii) the Initiative's support for re-
2 search and other activities on ethical, legal,
3 environmental, safety, security, and other
4 appropriate societal issues related to engi-
5 neering biology;
6 (iv) how the Initiative will move re-
7 sults out of the laboratory and into appli-
8 cation for the benefit of society and United
9 States competitiveness; and
10 (v) how the Initiative will measure
11 and track the contributions of engineering
12 biology to United States economic growth
13 and other societal indicators;
14 (4) develop a national genomic sequencing
15 strategy to ensure engineering biology research fully
16 leverages plant, animal, and microbe biodiversity to
17 enhance long-term innovation and competitiveness in
18 engineering biology in the United States;
19 (5) propose an annually coordinated interagency
20 budget for the Initiative that is intended to ensure—
21 (A) the maintenance of a robust engineer-
22 ing biology research and development portfolio;
23 and

1 (B) that the balance of funding across the
2 Initiative is sufficient to meet the goals and pri-
3 orities established for the Program;
4 (6) develop a plan to utilize Federal programs,
5 such as the Small Business Innovation Research
6 Program and the Small Business Technology Trans-
7 fer Program as described in section 9 of the Small
8 Business Act (15 U.S.C. 638), in support of the ac-
9 tivities described in section 4(b)(3); and
10 (7) in carrying out this section, take into con-
11 sideration the recommendations of the advisory com-
12 mittee established under section 6, the results of the
13 workshop convened under section 7, existing reports
14 on related topics, and the views of academic, State,
15 industry, and other appropriate groups.
16 (b) ANNUAL REPORT.—Beginning with fiscal year
17 2020, not later than 90 days after submission of the Presi-
18 dent's annual budget request and each fiscal year there-
19 after, the interagency committee shall prepare and submit
20 to the Committee on Science, Space, and Technology of
21 the House of Representatives and the Committee on Com-
22 merce, Science, and Transportation of the Senate a report
23 that includes—
24 (1) a summarized agency budget in support of
25 the Initiative for the fiscal year to which such budg-

1 et request applies, and for the then current fiscal
2 year, including a breakout of spending for each
3 agency participating in the Program and for the de-
4 velopment and acquisition of any research facilities
5 and instrumentation; and
6 (2) an assessment of how Federal agencies are
7 implementing the plan described in subsection
8 (a)(3), and a description of the amount and number
9 of awards made under the Small Business Innova-
10 tion Research Program and the Small Business
11 Technology Transfer Program (as described in sec-
12 tion 9 of the Small Business Act (15 U.S.C. 638))
13 in support of the Initiative.
14 (c) INITIATIVE STAFFING.—The President shall en-
15 sure adequate staffing for the Initiative, including full-
16 time staff within the Office of Science and Technology
17 Policy, who shall—
18 (1) provide technical and administrative support
19 to the interagency committee and the advisory com-
20 mittee established under section 6;
21 (2) serve as the point of contact on Federal en-
22 gineering biology activities for government organiza-
23 tions, academia, industry, professional societies,
24 State governments, interested citizen groups, and

1 others to exchange technical and programmatic in-
2 formation;
3 (3) oversee interagency coordination of the Ini-
4 tiative, including by encouraging and supporting
5 joint agency solicitation and selection of applications
6 for funding of activities under the Initiative;
7 (4) conduct public outreach, including dissemi-
8 nation of findings and recommendations of the advi-
9 sory committee established under section 6, as ap-
10 propriate; and
11 (5) promote access to, and early application of,
12 the technologies, innovations, and expertise derived
13 from Initiative activities to agency missions and sys-
14 tems across the Federal Government, and to United
15 States industry, including startup companies.
16 **SEC. 6. ADVISORY COMMITTEE.**
17 (a) IN GENERAL.—The President, acting through the
18 Office of Science and Technology Policy, shall designate
19 or establish an advisory committee on engineering biology
20 research and development (in this section referred to as
21 the "advisory committee") to be composed of not fewer
22 than 12 members, including representatives of research
23 and academic institutions, industry, and nongovernmental
24 entities, who are qualified to provide advice on the Initia-
25 tive.

1 (b) ASSESSMENT.—The advisory committee shall as-
2 sess—
3 (1) the current state of United States competi-
4 tiveness in engineering biology, including the scope
5 and scale of United States investments in engineer-
6 ing biology research and development in the inter-
7 national context;
8 (2) current market barriers to commercializa-
9 tion of engineering biology products, processes, and
10 tools in the United States;
11 (3) progress made in implementing the Initia-
12 tive;
13 (4) the need to revise the Initiative;
14 (5) the balance of activities and funding across
15 the Initiative;
16 (6) whether the strategic plan developed or up-
17 dated by the interagency committee established
18 under section 5 is helping to maintain United States
19 leadership in engineering biology;
20 (7) the management, coordination, implementa-
21 tion, and activities of the Initiative; and
22 (8) whether ethical, legal, environmental, safety,
23 security, and other appropriate societal issues are
24 adequately addressed by the Initiative.

1 (c) REPORTS.—Beginning not later than 2 years
2 after the date of enactment of this Act, and not less fre-
3 quently than once every 3 years thereafter, the advisory
4 committee shall submit to the President, the Committee
5 on Science, Space, and Technology of the House of Rep-
6 resentatives, and the Committee on Commerce, Science,
7 and Transportation of the Senate, a report on—
8 (1) the findings of the advisory committee's as-
9 sessment under subsection (b); and
10 (2) the advisory committee's recommendations
11 for ways to improve the Initiative.
12 (d) APPLICATION OF FEDERAL ADVISORY COM-
13 MITTEE ACT.—Section 14 of the Federal Advisory Com-
14 mittee Act (5 U.S.C. App.) shall not apply to the Advisory
15 Committee.

16 **SEC. 7. EXTERNAL REVIEW OF ETHICAL, LEGAL, ENVIRON-**
17 **MENTAL, AND SOCIETAL ISSUES.**

18 (a) IN GENERAL.—Not later than 12 months after
19 the date of enactment of this Act, the Director of the Na-
20 tional Science Foundation shall enter into an agreement
21 with the National Academies to convene a workshop to
22 review the ethical, legal, environmental, and other appro-
23 priate societal issues related to engineering biology re-
24 search and development. The goals of the workshop shall
25 be to—

1 (1) assess the current research on such issues;
2 (2) evaluate the research gaps relating to such
3 issues; and
4 (3) provide recommendations on how the Initia-
5 tive can address the research needs identified.
6 (b) REPORT TO CONGRESS.—Not later than 2 years
7 after the date of enactment of this Act, the Director of
8 the National Science Foundation shall transmit to the
9 Committee on Science, Space, and Technology of the
10 House of Representatives and the Committee on Com-
11 merce, Science, and Transportation of the Senate a sum-
12 mary report containing the findings of the workshop con-
13 vened under this section.
14 **SEC. 8. AGENCY ACTIVITIES.**
15 (a) NATIONAL SCIENCE FOUNDATION.—As part of
16 the Initiative, the National Science Foundation shall—
17 (1) support basic research in engineering biol-
18 ogy through individual grants and through inter-
19 disciplinary research centers;
20 (2) support research on the environmental,
21 legal, and social implications of engineering biology;
22 (3) provide support for research instrumenta-
23 tion for engineering biology disciplines, including
24 support for research, development, optimization and

1 validation of novel technologies to enable the dy-
2 namic study of molecular processes in situ; and
3 (4) award grants, on a competitive basis, to en-
4 able institutions to support graduate students and
5 postdoctoral fellows who perform some of their engi-
6 neering biology research in an industry setting.
7 (b) DEPARTMENT OF COMMERCE.—As part of the
8 Initiative, the Director of the National Institute of Stand-
9 ards and Technology shall—
10 (1) establish a bioscience research program to
11 advance the development of standard reference ma-
12 terials and measurements and to create new data
13 tools, techniques, and processes necessary to advance
14 engineering biology and biomanufacturing;
15 (2) provide access to user facilities with ad-
16 vanced or unique equipment, services, materials, and
17 other resources to industry, institutions of higher
18 education, nonprofit organizations, and government
19 agencies to perform research and testing; and
20 (3) provide technical expertise to inform the po-
21 tential development of guidelines or safeguards for
22 new products, processes, and systems of engineering
23 biology.
24 (c) DEPARTMENT OF ENERGY.—As part of the Ini-
25 tiative, the Secretary of Energy shall—

1 (1) conduct and support basic research, devel-
2 opment, demonstration, and commercial application
3 activities in engineering biology, including in the
4 areas of synthetic biology, advanced biofuel develop-
5 ment, biobased materials, and environmental remedi-
6 ation;
7 (2) support the development, optimization and
8 validation of novel, scalable tools and technologies to
9 enable the dynamic study of molecular processes in
10 situ; and
11 (3) provide access to user facilities with ad-
12 vanced or unique equipment, services, materials, and
13 other resources, as appropriate, to industry, institu-
14 tions of higher education, nonprofit organizations,
15 and government agencies to perform research and
16 testing.
17 (d) NATIONAL AERONAUTICS AND SPACE ADMINIS-
18 TRATION.—As part of the Initiative, the National Aero-
19 nautics and Space Administration shall—
20 (1) conduct and support basic and applied re-
21 search in engineering biology, including in synthetic
22 biology, and related to Earth and space sciences,
23 aeronautics, space technology, and space exploration
24 and experimentation, consistent with the priorities

1 established in the National Academies' decadal sur-
2 veys; and
3 (2) award grants, on a competitive basis, that
4 enable institutions to support graduate students and
5 postdoctoral fellows who perform some of their engi-
6 neering biology research in an industry setting.
7 (e) ENVIRONMENTAL PROTECTION AGENCY.—As
8 part of the Initiative, the Environmental Protection Agen-
9 cy shall support research on how products, processes, and
10 systems of engineering biology will affect or can protect
11 the environment.

Chairwoman JOHNSON. Without objection, the bill is considered as read and open to amendment at any point.

I recognize myself briefly to speak on this bill.

I've already made some comments on the importance of the issue of national competitiveness. Other countries have already made investing in engineering biology a national priority for some years now. China recently reported that their bioeconomy is growing by 15 percent annually and is expected to generate $1.6 trillion in revenues in 2020. It is past time for the United States to recognize the significance of this emerging area of research.

The Committee undertook a months-long effort to seek expert input and update the legislation before us to reflect the current state of science and technology and to adequately address the full suite of societal issues. I want to thank Ranking Member Lucas and his staff for partnering with us in this effort. I also want to thank Mr. Sensenbrenner and Ms. Lofgren for joining us as original cosponsors and Ms. Hill, Mr. Foster, Mr. Fitzpatrick, and Miss González-Colon for also cosponsoring the measure.

H.R. 4373 has already been endorsed by the Biotechnology Innovation Organization and several other important groups. I'll put the full list into the record.

This is a good bipartisan bill and an important step in ensuring U.S. leadership in the bioeconomy of the 21st century. I urge my colleagues to support this legislation.

If anyone would wish to be recognized?

Mr. LUCAS. Madam Chair?

Chairwoman JOHNSON. Mr. Lucas.

Mr. LUCAS. Thank you, Madam Chair. In both the House Agriculture Committee and the Science Committee we've discussed biotechnology research and regulation for years, but I can't remember a more exciting and challenging time for the field than today. New gene editing techniques like CRISPR and the advancement of rapid genetic sequencing are driving innovations in agriculture, medicine, energy, and manufacturing.

The U.S. was a key driver of biology innovation in the 20th century, but there is an increasing global competition. Other countries recognize the benefits of biotechnology and are striving to capture its potential through new investments and friendly regulations. We must keep pace and set a research and regulatory framework that supports innovation, creates a marketplace for new ideas and products, while setting the safety and ethical standards for the world to follow.

H.R. 4373, the *Engineering Biology Research and Development Act*, will help us meet those challenges. The bill authorizes a coordinated Federal research initiative to ensure that the United States remains the leader in engineering biology. Next month, the White House is convening a summit with the Nation's foremost bioeconomy leaders from industry, academia, and government for discussion on maintaining American economic and security leadership in biology. I hope that summit, along with this bill, will build momentum for a serious national public-private effort to advance and protect U.S. bioeconomy.

I'm pleased this bill has gained the endorsement of BIO, the Biotechnology Innovation Organization, and other biology stake-

holders. I look forward to working with the Chairwoman to move this bill forward in the House and the Senate, and I urge my colleagues to support it.

And with that, I yield back, Madam Chair.

Chairwoman JOHNSON. Thank you very much.

We will now proceed with the amendments in the order on the roster. The first amendment on the roster is an amendment offered by the Chair. The clerk will report the amendment.

The CLERK. Amendment No. 1, amendment to H.R. 4373, offered by Ms. Johnson.

[The amendment of Chairwoman Johnson follows:]

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AMENDMENT TO H.R. 4373

OFFERED BY MS. Johnson

[Page and line numbers refer to ENGINEERBIO_02 with timestamp of September 16, 2019 (4:30 p.m.) posted by the Committee on Science, Space, and Technology.]

Page 4, line 1, insert "or optimize" after "novel".

Page 17, line 18, strike "12" and insert "6".

Page 17, line 21, strike "to convene" and all that follows through "ethical," on line 22, and insert the following: "of Sciences, Engineering, and Medicine to conduct a review, and make recommendations with respect to, the ethical,".

Page 17, line 24, strike "goals of" and all that follows through "be to" on line 25, and insert the following: "review shall include".

Page 18, line 1, strike "assess" and insert "an assessment of".

Page 18, line 2, strike "evaluate" and insert "a description of".

Page 18, line 3, strike "and" at the end.

Page 18, line 4, strike "provide".

Page 18, line 5, strike "identified." and insert "identified pursuant to paragraph (2); and".

Page 18, after line 5, add the following:

1 (4) recommendations on how engineering biol-
2 ogy researchers can best incorporate considerations
3 of ethical, legal, environmental, and other societal
4 issues into the development of research proposals
5 and the conduct of research.

Page 18, strike lines 6 through 13 and insert the following:

6 (b) REPORT TO CONGRESS.—The agreement entered
7 into under subsection (a) shall require the National Acad-
8 emy of Sciences, Engineering, and Medicine to, not later
9 than 2 years after the date of the enactment of this Act—
10 (1) submit to the Committee on Science, Space,
11 and Technology of the House of Representatives and
12 the Committee on Commerce, Science, and Trans-
13 portation of the Senate a report containing the find-
14 ings and recommendations of the review conducted
15 under subsection (a); and
16 (2) make a copy of such report available on a
17 publicly accessible website.

Page 19, line 2, strike "and" at the end.

Page 19, after line 2, insert the following:

1 (4) support curriculum development and re-
2 search experiences for secondary, undergraduate,
3 and graduate students in engineering biology and
4 biomanufacturing; and

Page 19, line 3, strike "(4)" and insert "(5)".

☒

Chairwoman JOHNSON. I ask unanimous consent to dispense with the reading. And without objection, so ordered.

I recognize myself for 5 minutes to explain the amendment.

This amendment makes technical corrections to the underlying legislation. In addition, it adds curriculum development for secondary education and engineering biology to the list of activities to be supported by the National Science Foundation. Finally, it updates the required study by the National Academies to include recommendations for researchers on how best to incorporate consideration of ethical and other societal issues into the design and conduct of their research.

I want to thank Ranking Member Lucas for working with me on this amendment, and I urge my colleagues to support it.

Is there further discussion on the amendment?

Mr. LUCAS. Madam Chair?

Chairwoman JOHNSON. Mr. Lucas.

Mr. LUCAS. Thank you, Madam Chair. I appreciate you working with us through the process to address stakeholder feedback. This amendment makes further improvements to the bill in response to their comments, and I urge my colleagues to support it.

And with that, I yield back, Madam Chair.

Chairwoman JOHNSON. Thank you very much. The vote now occurs on the amendment.

All in favor, say aye.

Those opposed, no.

The ayes have it, and the amendment is agreed to.

Are there any other amendments?

If no, a reporting quorum being present, I move that the Committee on Science, Space, and Technology report H.R. 4373, as amended, to the House with the recommendation that the bill be approved.

Those in favor, motion by signifying aye.

Those opposed, nay.

The ayes have it, and the bill is favorably reported.

Without objection, the motion to reconsider is laid upon the table, and I ask unanimous consent that the staff be authorized to make any necessary technical and conforming changes to the bill. Without objection, so ordered.

Members will have 2 subsequent calendar days in which to submit supplementary minority and additional views on the measure.

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