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HOUSE OF REPRESENTATIVES
REPORT
116–268

IDENTIFYING OUTPUTS OF GENERATIVE ADVERSARIAL NETWORKS ACT

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. 4355]

[Including cost estimate of the Congressional Budget Office]

The Committee on Science, Space, and Technology, to whom was referred the bill (H.R. 4355) to direct the Director of the National Science Foundation to support research on the outputs that may be generated by generative adversarial networks, otherwise known as deepfakes, and other comparable techniques that may be developed in the future, and for other purposes, having considered the same, report favorably thereon with an amendment and recommend that the bill as amended do pass.

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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 "Identifying Outputs of Generative Adversarial Networks Act" or the "IOGAN Act".

SEC. 2. FINDINGS.

Congress finds the following:

(1) Research gaps currently exist on the underlying technology needed to develop tools to identify authentic videos, voice reproduction, or photos from manipulated or synthesized content, including those generated by generative adversarial networks.

(2) The National Science Foundation's focus to support research in artificial intelligence through computer and information science and engineering, cognitive science and psychology, economics and game theory, control theory, linguistics, mathematics, and philosophy, is building a better understanding of how new technologies are shaping the society and economy of the United States.

(3) The National Science Foundation has identified the "10 Big Ideas for NSF Future Investment" including "Harnessing the Data Revolution" and the "Future of Work at the Human-Technology Frontier", in with artificial intelligence is a critical component.

(4) The outputs generated by generative adversarial networks should be included under the umbrella of research described in paragraph (3) given the grave national security and societal impact potential of such networks.

(5) Generative adversarial networks are not likely to be utilized as the sole technique of artificial intelligence or machine learning capable of creating credible deepfakes and other comparable techniques may be developed in the future to produce similar outputs.

SEC. 3. NSF SUPPORT OF RESEARCH ON MANIPULATED OR SYNTHESIZED CONTENT AND INFORMATION SECURITY.

The Director of the National Science Foundation, in consultation with other relevant Federal agencies, shall support merit-reviewed and competitively awarded research on manipulated or synthesized content and information authenticity, which may include—

(1) fundamental research on digital forensic tools or other technologies for verifying the authenticity of information and detection of manipulated or synthesized content, including content generated by generative adversarial networks;

(2) fundamental research on technical tools for identifying manipulated or synthesized content, such as watermarking systems for generated media;

(3) social and behavioral research related to manipulated or synthesized content, including the ethics of the technology and human engagement with the content;

(4) research on public understanding and awareness of manipulated and synthesized content, including research on best practices for educating the public to discern authenticity of digital content; and

(5) research awards coordinated with other federal agencies and programs including the Networking and Information Technology Research and Development Program, the Defense Advanced Research Projects Agency and the Intelligence Advanced Research Projects Agency.

SEC. 4. NIST SUPPORT FOR RESEARCH AND STANDARDS ON GENERATIVE ADVERSARIAL NETWORKS.

(a) IN GENERAL.—The Director of the National Institute of Standards and Technology shall support research for the development of measurements and standards necessary to accelerate the development of the technological tools to examine the function and outputs of generative adversarial networks or other technologies that synthesize or manipulate content.

(b) OUTREACH.—The Director of the National Institute of Standards and Technology shall conduct outreach—

(1) to receive input from private, public, and academic stakeholders on fundamental measurements and standards research necessary to examine the function and outputs of generative adversarial networks; and

(2) to consider the feasibility of an ongoing public and private sector engagement to develop voluntary standards for the function and outputs of generative

adversarial networks or other technologies that synthesize or manipulate content.

SEC. 5. REPORT ON FEASIBILITY OF PUBLIC-PRIVATE PARTNERSHIP TO DETECT MANIPULATED OR SYNTHESIZED CONTENT.

Not later than one year after the date of the enactment of this Act, the Director of the National Science Foundation and the Director of the National Institute of Standards and Technology shall jointly submit to the Committee on Space, Science, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation a report containing—

(1) the Directors' findings with respect to the feasibility for research opportunities with the private sector, including digital media companies to detect the function and outputs of generative adversarial networks or other technologies that synthesize or manipulate content; and

(2) any policy recommendations of the Directors that could facilitate and improve communication and coordination between the private sector, the National Science Foundation, and relevant Federal agencies through the implementation of innovative approaches to detect digital content produced by generative adversarial networks or other technologies that synthesize or manipulate content.

SEC. 6. GENERATIVE ADVERSARIAL NETWORK DEFINED.

In this Act, the term "generative adversarial network" means, with respect to artificial intelligence, the machine learning process of attempting to cause a generator artificial neural network (referred to in this paragraph as the "generator" and a discriminator artificial neural network (referred to in this paragraph as a "discriminator") to compete against each other to become more accurate in their function and outputs, through which the generator and discriminator create a feedback loop, causing the generator to produce increasingly higher-quality artificial outputs and the discriminator to increasingly improve in detecting such artificial outputs.

II. PURPOSE OF THE BILL

The purpose of the bill is to provide for research on manipulated or synthesized content and information authenticity, including output of generative adversarial networks, otherwise known as deepfakes and to encourage public-private partnerships to develop standards for detecting and identifying such content.

III. BACKGROUND AND NEED FOR THE LEGISLATION

Disinformation in its many forms has long been used by governments and rogue organizations and individuals as a weapon against adversaries. The problem has become more pervasive in the past decade with the explosive growth of social media, which provides an opportunity for hostile actors to project disinformation directly into the popular discourse at little cost.

Advancements in computing power and the widespread use of artificial intelligence over the past several years have made it easier and cheaper than ever before to manipulate and reproduce photographs and video and audio clips potentially harmful or deceptive to the American public and to the integrity of our democratic institutions and processes, including fake videos featuring "people" who do not really exist. AI programs can also write convincing articles and blog posts that seem to be written by real humans. This technology, often referred to as "deepfake technology" has developed rapidly over the past several years with no clear method of identifying and stopping it from becoming a major threat to national security, economic security, or public health. The ability to identify and label this content is critical to preventing bad actors from using manipulated images and videos to shift U.S. public opinion. While the deep fake technology continues to mature, researchers are only beginning to develop the knowledge and tools that will

help the public and private sector distinguish authentic content from manipulated or synthesized content.

IV. Committee Hearings

On September 26, 2019, the Investigations and Oversight Subcommittee held a hearing entitled, "Online Imposters and Disinformation." The purpose of the hearing was to explore the enabling technologies for disinformation online, including deep fakes, explore trends and emerging technology in the field, and consider research strategies that can help stem the tide of malicious inauthentic behavior. The hearing featured a demonstration of a deep fake video created using the words and video of two Members of Congress.

Three witnesses testified: Dr. Hany Farid, Professor, Electrical Engineering & Computer Science and the School of Information, University of California, Berkeley; Dr. Siwei Lyu, Professor, Department of Computer Science, Director, Computer Vision and Machine Learning Lab, University at Albany, State University of New York; and Ms. Camille Francois; Chief Innovation Officer, Graphika.

V. Committee Consideration and Votes

On September 17, 2019 Rep. Anthony Gonzalez and Rep. Haley Stevens, as well as Rep. Jim Baird and Rep. Katie Hill, introduced H.R. 4355, the Identifying Outputs of Generative Adversarial Networks Act. The bill was referred to the House Science, Space, and Technology Committee.

On September 25, 2019, the Committee met to consider H.R. 4355. Mr. Gonzalez offered an amendment in the nature of a substitute to make technical corrections and conforming changes. The amendment was agreed to by voice vote. Mr. Beyer introduced an amendment to the amendment to include fundamental research on technical tools for identifying manipulated or synthesized content, such as watermarking systems for generated media. The amendment was agreed to by voice vote. Ms. Wexton introduced an amendment to the amendment to include research on public understanding and awareness of manipulated or synthesized content, including research on best practices. The amendment was agreed to by voice vote. Ms. Johnson moved that the Committee favorably report the bill, H.R. 4355, to the House with the recommendation that the bill be approved. The motion was agreed to by voice vote.

VI. Summary of Major Provisions of the Bill

The Act directs the National Science Foundation (NSF) to support research on manipulated or synthesized content and information security, including fundamental research on digital media forensic tools, social and behavioral research, and research awards coordinated with other federal agencies and programs including NITRD, DARPA and IARPA.

The Act directs the National Institute of Standards and Technology (NIST) to support research for the development of measurements and standards necessary to accelerate the development of technological tools to examine the function and outputs of genera-

tive adversarial networks and other technologies that synthesize or manipulate content.

Further the Act directs NSF and NIST to jointly submit to Congress a report on the feasibility of and policy recommendations for a public-private partnership for research to detect manipulated or synthesized content.

VII. SECTION-BY-SECTION ANALYSIS (BY TITLE AND SECTION)

Section 1. Short title

Identifying Outputs of Generative Adversarial Networks Act or the IOGAN Act.

Section 2. Findings

Provides findings for the Act that there are research gaps on the underlying technology needed to develop tools to identify authentic videos, voice reproduction, or photos and those generated by generative adversarial networks (otherwise known as "deepfakes"), and that there is a role for the NSF in conducting research on these gaps including social and behavioral research.

Section 3. NSF support of research on manipulated or synthesized content and information security

Directs the National Science Foundation, in consultation with other Federal agencies, to conduct research on manipulated or synthesized content and information authenticity, including fundamental research on digital forensic tools and social and behavioral research on the ethics of the technology and human engagement with the content.

Section 4. NIST support for research and standards on generative adversarial networks

Directs the National Institute of Standards and Technology to support research for the development of measurements and standards necessary to accelerate the development of the technological tools to examine the function and outputs of generative adversarial networks and other technologies that synthesize or manipulate content; Directs NIST to solicit input from private, public, and academic stakeholders; Directs NIST to consider the feasibility of an ongoing public and private sector engagement to develop voluntary standards for the outputs of generative adversarial networks and other technologies.

Section 5. Report on feasibility of public-private partnership to detect manipulated or synthesized content

Directs NSF and NIST to jointly submit to Congress a report on opportunities for research partnerships with the private sector on generative adversarial networks or other technologies that synthesize or manipulate content.

Section 6. Generative adversarial network defined

Provides a definition for "generative adversarial network".

VIII. Committee Views

The intent of this legislation is to accelerate the progress of research and the development of measurements, standards, and tools to combat manipulated media content, including the outputs of generative adversarial networks, commonly called "deepfakes."

The Committee recognizes that NSF is already making investments in the area of manipulated or synthesized content through its Secure and Trustworthy Cyberspace (SaTC) and Robust Intelligence (RI) programs. The Committee encourages NSF to continue to fund cross-directorate research through these programs and others to achieve the purposes of this Act, including social and behavioral research on the ethics of these technologies and human interaction with the content generated by these technologies.

The Committee intends for NSF and NIST, in carrying out this Act, to work with other agencies conducting work on detecting manipulated and synthesized content, including DARPA, IARPA and the agencies that participate in the NITRD program, to ensure coordination and avoid duplication of effort.

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, October 29, 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. 4355, the Identifying Outputs of Generative Adversarial Networks Act.

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. 4355, Identifying Outputs of Generative Adversarial Networks Act
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)	2	6	not estimated

Statutory pay-as-you-go procedures apply?	No	Mandate Effects	
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. 4355 would require the National Science Foundation (NSF) to support research on manipulated digital content and information authenticity. The bill also would direct the National Institute of Standards and Technology (NIST) to create measurements and standards for the development of technological tools that examine generative adversarial networks (GANs), which are used to produce manipulated content.

Using information from the NSF, CBO estimates that implementing the bill would have no significant cost for the NSF because the agency is already carrying out the required activities through its existing grant programs. Using information from NIST, CBO estimates that the agency would require 10 additional employees at an average annual cost of $175,000 each over the 2020–2022 period to establish a research program on GANs and similar technologies. The bill also would direct NIST and the NSF to report to the Congress on related policy recommendations. Based on the costs of similar tasks, CBO estimates that developing the report would cost less than $500,000. In total, CBO estimates that implementing H.R. 4355 would cost $6 million over the 2020–2024 period; such spending would be subject to the availability of appropriated funds.

The CBO staff contacts for this estimate are Janani Shankaran and David Hughes. The estimate was reviewed by H. Samuel Papenfuss, Deputy Assistant Director for Budget Analysis.

XI. Federal Mandates Statement

H.R. 4355 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

The goal of this legislation is to support research and development on technical and other tools to assist the public and private sectors in identifying manipulated and synthesized content online.

XIV. Federal Advisory Committee Statement

H.R. 4355 does not create any advisory committees.

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. 4355 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. 4355 contains no earmarks, limited tax benefits, or limited tariff benefits.

XVII. Applicability to the Legislative Branch

The Committee finds that H.R. 4355 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

ONE HUNDRED SIXTEENTH CONGRESS

FIRST SESSION

SEPTEMBER 25, 2019

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C O N T E N T S

September 25, 2019

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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.

H.R. 4373 creates the foundation for U.S. leadership in the bio-economy 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. Fi-

nally, throughout the legislation, 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 talent. For our country to remain competitive in the 21st Century, this situation must change. Fortunately, America's minority serving institutions 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 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 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 the research competitiveness of MSIs. Finally, the bill directs the Office of Science and Technology Policy to develop a government-wide strategic plan and sustained outreach program to support STEM education and research at MSIs.

The last bill we will 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 and the National Institute of Standards and Technology 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.

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.

Finally, we will consider H.R. 4355, the *Identifying Outputs of Generative Adversarial Networks Act*, introduced by Representative Anthony Gonzalez.

Generative Adversarial Networks use machine learning to manipulate videos and other digital content to produce misleading and false products, commonly known as

"Deepfakes." 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 divisions 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 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. 4355

Chairwoman JOHNSON. H.R. 4355 is now under consideration, the *Identifying Outputs of Generative Adversarial Networks Act*. The clerk will report the bill.

The CLERK. H.R. 4355, a bill.

[The bill follows:]

.....

(Original Signature of Member)

116TH CONGRESS
1ST SESSION

H. R. _____

To direct the Director of the National Science Foundation to support research on the outputs that may be generated by generative adversarial networks, otherwise known as deepfakes, and other comparable techniques that may be developed in the future, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

Mr. GONZALEZ of Ohio introduced the following bill; which was referred to the Committee on _____

A BILL

To direct the Director of the National Science Foundation to support research on the outputs that may be generated by generative adversarial networks, otherwise known as deepfakes, and other comparable techniques that may be developed in the future, and for other purposes.

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 "Identifying Outputs of Generative Adversarial Networks Act" or the "IOGAN Act".

SEC. 2. FINDINGS.

Congress finds the following:

(1) Research gaps currently exist on the underlying technology needed to develop tools to identify authentic videos, voice reproduction, or photos from those generated by generative adversarial networks.

(2) The National Science Foundation's focus to support research in artificial intelligence through computer and information science and engineering, cognitive science and psychology, economics and game theory, control theory, linguistics, mathematics, and philosophy, is building a better understanding of how new technologies are shaping the society and economy of the United States.

(3) The National Science Foundation has identified the "10 Big Ideas for NSF Future Investment" including "Harnessing the Data Revolution" and the "Future of Work at the Human-Technology Frontier", in with artificial intelligence is a critical component.

(4) The outputs generated by generative adversarial networks should be included under the um-

brella of research described in paragraph (3) given the grave national security and societal impact potential of such networks.

(5) Generative adversarial networks are not likely to be utilized as the sole technique of artificial intelligence or machine learning capable of creating credible deepfakes and other comparable techniques may be developed in the future to produce similar outputs.

SEC. 3. NSF SUPPORT OF RESEARCH FOR OUTPUTS OF GENERATIVE ADVERSARIAL NETWORKS.

The Director of the National Science Foundation, in consultation with other relevant Federal agencies, shall support merit-reviewed and competitively awarded research on the science and ethics of material produced by generative adversarial networks, which may include—

(1) supplementing fundamental research on digital media forensic tools or comparable technologies for detection of the outputs of generative adversarial networks completed by the Defense Advanced Research Projects Agency and the Intelligence Advanced Research Projects Activity;

(2) fundamental research on developing constraint aware generative adversarial networks; and

(3) social and behavioral research on the ethics of the technology, and human engagement with the networks.

SEC. 4. NIST SUPPORT FOR RESEARCH AND STANDARDS ON GENERATIVE ADVERSARIAL NETWORKS.

(a) IN GENERAL.—The Director of the National Institute of Standards and Technology shall support research for the development of measurements and standards necessary to accelerate the development of the technological tools to examine the function and outputs of generative adversarial networks.

(b) OUTREACH.—The Director of the National Institute of Standards and Technology shall conduct outreach—

(1) to receive input from private, public, and academic stakeholders on fundamental measurements and standards research necessary to examine the function and outputs of generative of generative adversarial networks or to develop constraint aware generative adversarial networks; and

(2) to consider the feasibility of an ongoing public and private sector engagement to develop voluntary standards for the outputs of generative adversarial networks or comparable technologies.

SEC. 5. REPORT ON FEASIBILITY OF PUBLIC-PRIVATE PARTNERSHIP TO DETECT OUTPUTS OF GENERATIVE ADVERSARIAL NETWORKS AND COMPARABLE TECHNOLOGIES.

Not later than one year after the date of the enactment of this Act, the Director of the National Science Foundation and the Director of the National Institute of Standards and Technology shall jointly submit to the Committee on Space, Science, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation a report containing—

(1) the Directors' findings with respect to the feasibility for research opportunities with the private sector, including digital media companies to detect the outputs of generative adversarial networks or comparable technologies; and

(2) any policy recommendations of the Directors that could facilitate and improve communication and coordination between the private sector, the National Science Foundation, and relevant Federal agencies through the implementation of innovative approaches to detect media products produced by generative adversarial networks or comparable technologies.

SEC. 6. DEFINITIONS.

In this Act:

(1) GENERATIVE ADVERSARIAL NETWORK.—The term "generative adversarial network" means, with respect to artificial intelligence, the machine learning process of attempting to cause a generator artificial neural network (referred to in this paragraph as the "generator" and a discriminator artificial neural network (referred to in this paragraph as a "discriminator") to compete against each other to become more accurate in their function and outputs, through which the generator and discriminator create a feedback loop, causing the generator to produce increasingly higher-quality artificial outputs and the discriminator to increasingly improve in detecting such artificial outputs.

(2) COMPARABLE TECHNOLOGY.—The term "comparable technology" means technology that utilizes similar techniques to achieve the same outputs as a generative adversarial network.

(3) CONSTRAINT AWARE.—The term "constraint aware" means, with respect to artificial intelligence, the generation of realistic relational data by a machine with constraint on the modules generated by an adversarial network.

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

I will recognize the bill's sponsor, Mr. Gonzalez, to speak on the bill.

Mr. GONZALEZ. Thank you. I want to thank Ranking Member Lucas, Chairwoman Johnson, my colleagues in this Committee, and Committee staff from both sides of the aisle for their input in writing this legislation and for allowing for its full consideration. I urge my colleagues to support my legislation, the *Identifying Outputs of Generative Adversarial Networks Act*—a bit of a tongue twister, as we're all trying to pronounce it—but to direct research on the underlying technology used to produce deep fakes. The *IOGAN Act* will allow us to develop much-needed tools to identify authentic videos, voice reproduction, or photos generated by deep fakes.

Deep fakes are not a new phenomenon. I assume most of you have seen the movie Forrest Gump. It's one of my favorites of all time. If you have, you'll remember some of the famous scenes where Forrest Gump was filmed shaking hands with various Presidents, was fighting in Vietnam, and all sorts of different things throughout the video. At the time, the technique was revolutionary and it was incredibly expensive and difficult to reproduce to the point that really only big Hollywood studios with massive budgets could afford to produce deep fakes with such images.

So fast-forward a few decades later after Forrest Gump, and we now live in a world where advances in technology and computing power have increased exponentially. This increase in power has enabled techniques like GANs to be developed, making deep fakes easier and cheaper than ever to be produced and disseminated on the internet. Techniques to produce deep fakes are constantly improving and has made it extremely difficult to distinguish between fact and fiction. Experts say that eventually techniques will get so refined that deep fakes will be indistinguishable from real recordings, pictures, or videos.

Given the national security and societal implications that deep fakes can pose for our country, my legislation directs the NSF, in consultation with other Federal agencies, to conduct research on the science and ethics of deep fakes. This includes fundamental research on digital forensic tools and social and behavioral research on the human engagement with the networks.

My bill also directs NIST to support research for the development of measurements and standards necessary to accelerate the advance of the technological tools to examine the function and outputs of any type of deep fake technology.

The legislation also directs NSF and NIST to jointly submit a report on the feasibility of research opportunities through public-private partnerships. The goal here is to identify new emerging technologies that could produce deep fakes by using different techniques. The report shall also provide Congress with any recommendations that could facilitate and improve the communication and coordination between the private sector and Federal agencies to devise innovative techniques in the detection of deep fakes.

Finally, I would like to add that the ability to identify and label deep fake content is critical to preventing foreign actors or terrorist

organizations from using manipulated media to influence U.S. public opinion.

I'm proud to see the *IOGAN Act* addressing the needs to educate and train a new type of workforce in digital forensics, which will be a profession that will be in greater demand for many years to come.

One of my colleagues on the other side of the aisle likes to say, if we're going to be divided, gosh dang it, it better be with real information and among Americans. You know who I'm talking about. And I share that. And so this bill, my hope is, will be a factor in making sure that the content that's being produced and presented into our public discourse is genuine and real.

I also want to take the time to thank Representatives Stevens, Baird, and Katie Hill for their support. With that, I urge my colleagues to support H.R. 4355, and I yield back.

Chairwoman JOHNSON. Thank you very much.

Anyone else wishing to be recognized?

Ms. STEVENS. Chairwoman Johnson, I move to strike the last word.

Chairwoman JOHNSON. Ms. Stevens.

Ms. STEVENS. Thank you, Chairwoman Johnson. I'm proud to lead on this bill with my friend Congressman Anthony Gonzalez to promote national security and combat malicious use of generative adversarial networks. And he's absolutely right that we all love the movie Forrest Gump but can recognize that the complicated and oftentimes expensive technology of big Hollywood has gotten into the hands of individual actors for bad intent and to confuse citizens. So this bill supports critical research to identify manipulated media content known as deep fakes that threaten to erode public discourse, scam the American public, and endanger our national security.

Deep fake technology has developed rapidly over the past several years with no clear method of identifying and stopping it from becoming a major national security threat. H.R. 4355, the *Identifying Outputs of Generative Adversarial Network Act*, directs the National Science Foundation and the National Institute of Standards and Technology to support research to accelerate the development of technologies that could improve the detection of deep fakes and what incredible agencies to do that work. So we're confident that this bill is a step in the right direction to tackle these challenges.

Advancements in computing power and the widespread use of technologies like artificial intelligence particularly over the last several years have made it easier and cheaper more than ever before to manipulate and reproduce photographs, videos, and audio clips that are potentially harmful or deceptive to the American public. Deep fake videos have also been used to alter footage of celebrities, politicians, and CEOs to confuse or scam the American people. And the technology is quickly evolving to be able to mimic any person to create false footage of words and actions.

So it's not only time for us to study this, but it's also time for us to certainly get serious and to develop some standards and cybersecurity controls. The ability to identify and label this content is critical to preventing bad actors from using manipulated images

and videos for disinformation campaigns, blackmail, and other malicious activities.

So, again, I'd like to thank the fellow leaders on this bill, Mr. Gonzalez, Ms. Hill, and Dr. Baird, for taking action on such an important topic to preserve our national security and public trust. And I yield back the remainder of my time.

Chairwoman JOHNSON. Thank you very much.

Anyone else seeking time?

We will now proceed with the amendments in order on the roster. The first amendment on the roster is an amendment offered by the gentleman from Ohio, and he's recognized to offer an amendment.

Mr. GONZALEZ. Thank you, Chairwoman Johnson.

I have an amendment at the desk.

Chairwoman JOHNSON. The clerk will report the amendment.

The CLERK. Amendment No. 1, amendment in the nature of a substitute to H.R. 4355 offered by Mr. Gonzalez.

[The amendment of Mr. Gonzalez follows:]

AMENDMENT IN THE NATURE OF A SUBSTITUTE TO H.R. 4355

OFFERED BY M__. _____

[Page and line numbers refer to GANS_01 with timestamp of September 17, 2019 at 2:11PM posted by the Committee on Science, Space, and Technology]

Strike all after the enacting clause and insert the following:

SECTION 1. SHORT TITLE.

This Act may be cited as the "Identifying Outputs of Generative Adversarial Networks Act" or the "IOGAN Act".

SEC. 2. FINDINGS.

Congress finds the following:

(1) Research gaps currently exist on the underlying technology needed to develop tools to identify authentic videos, voice reproduction, or photos from manipulated or synthesized content, including those generated by generative adversarial networks.

(2) The National Science Foundation's focus to support research in artificial intelligence through computer and information science and engineering, cognitive science and psychology, economics and game theory, control theory, linguistics, mathe-

maties, and philosophy, is building a better understanding of how new technologies are shaping the society and economy of the United States.

(3) The National Science Foundation has identified the "10 Big Ideas for NSF Future Investment" including "Harnessing the Data Revolution" and the "Future of Work at the Human-Technology Frontier", in with artificial intelligence is a critical component.

(4) The outputs generated by generative adversarial networks should be included under the umbrella of research described in paragraph (3) given the grave national security and societal impact potential of such networks.

(5) Generative adversarial networks are not likely to be utilized as the sole technique of artificial intelligence or machine learning capable of creating credible deepfakes and other comparable techniques may be developed in the future to produce similar outputs.

SEC. 3. NSF SUPPORT OF RESEARCH ON MANIPULATED OR SYNTHESIZED CONTENT AND INFORMATION SECURITY.

The Director of the National Science Foundation, in consultation with other relevant Federal agencies, shall

support merit-reviewed and competitively awarded research on manipulated or synthesized content and information authenticity, which may include—

(1) fundamental research on digital forensic tools or other technologies for verifying the authenticity of information and detection of manipulated or synthesized content, including content generated by generative adversarial networks;

(2) social and behavioral research related to manipulated or synthesized content, including the ethics of the technology and human engagement with the content; and

(3) research awards coordinated with other federal agencies and programs including the Networking and Information Technology Research and Development Program, the Defense Advanced Research Projects Agency and the Intelligence Advanced Research Projects Agency.

SEC. 4. NIST SUPPORT FOR RESEARCH AND STANDARDS ON GENERATIVE ADVERSARIAL NETWORKS.

(a) IN GENERAL.—The Director of the National Institute of Standards and Technology shall support research for the development of measurements and standards necessary to accelerate the development of the technological tools to examine the function and outputs of gen-

erative adversarial networks or other technologies that synthesize or manipulate content.

(b) OUTREACH.—The Director of the National Institute of Standards and Technology shall conduct outreach—

(1) to receive input from private, public, and academic stakeholders on fundamental measurements and standards research necessary to examine the function and outputs of generative adversarial networks; and

(2) to consider the feasibility of an ongoing public and private sector engagement to develop voluntary standards for the function and outputs of generative adversarial networks or other technologies that synthesize or manipulate content.

SEC. 5. REPORT ON FEASIBILITY OF PUBLIC-PRIVATE PARTNERSHIP TO DETECT MANIPULATED OR SYNTHESIZED CONTENT.

Not later than one year after the date of the enactment of this Act, the Director of the National Science Foundation and the Director of the National Institute of Standards and Technology shall jointly submit to the Committee on Space, Science, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation a report containing—

(1) the Directors' findings with respect to the feasibility for research opportunities with the private sector, including digital media companies to detect the function and outputs of generative adversarial networks or other technologies that synthesize or manipulate content; and

(2) any policy recommendations of the Directors that could facilitate and improve communication and coordination between the private sector, the National Science Foundation, and relevant Federal agencies through the implementation of innovative approaches to detect digital content produced by generative adversarial networks or other technologies that synthesize or manipulate content.

SEC. 6. GENERATIVE ADVERSARIAL NETWORK DEFINED.

In this Act, the term "generative adversarial network" means, with respect to artificial intelligence, the machine learning process of attempting to cause a generator artificial neural network (referred to in this paragraph as the "generator" and a discriminator artificial neural network (referred to in this paragraph as a "discriminator") to compete against each other to become more accurate in their function and outputs, through which the generator and discriminator create a feedback loop, causing the generator to produce increasingly higher-

quality artificial outputs and the discriminator to increasingly improve in detecting such artificial outputs.

Amend the title so as to read: "A bill to direct the Director of the National Science Foundation to support research on manipulated or synthesized content and information authenticity, including the output of generative adversarial networks, otherwise known as deepfakes, and for other purposes".

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

We recognize the gentleman for 5 minutes to explain his amendment.

Mr. GONZALEZ. Thank you, Chairwoman Johnson.

My amendment looks to include technical feedback provided by NSF, NIST, and outside experts and improves the underlying legislation. This will not take 5 minutes. I urge my colleagues to support the amendment, and I yield back my time.

Chairwoman JOHNSON. Thank you, Mr. Gonzalez. I support the amendment, and I thank the gentleman for working with me and my staff on both the amendment and the underlying bill.

Is there any other discussion on the amendment?

Mr. LUCAS. Madam Chair?

Chairwoman JOHNSON. Mr. Lucas?

Mr. LUCAS. Thank you, Madam Chair.

I support the gentleman's amendment in the nature of a substitute. This amendment makes improvements to the bill based on agency and stakeholder feedback, as well as input from Committee staff on both sides of the aisle. I want to thank Mr. Gonzalez and his staff for working with us on this amendment and thank you, Chairwoman Johnson, for marking up this bill today. I urge my colleagues to support this amendment, as well as the other two amendments that will be offered to this bill. All will further improve this good piece of legislation. With that, I yield back, Madam Chair.

Chairwoman JOHNSON. Thank you very much.

Are there any other comments?

We will move to the next amendment and vote on the Gonzalez amendment later.

The Beyer amendment, the next amendment on the roster is an amendment offered by the gentleman from Virginia. He's recognized to offer an amendment.

Mr. BEYER. Thank you, Madam Chair. I have an amendment at the desk.

Chairwoman JOHNSON. The clerk will report the amendment.

The CLERK. Amendment No. 2, amendment to the amendment in the nature of a substitute to——

[The amendment of Mr. Beyer follows:]

AMENDMENT TO THE AMENDMENT IN THE NATURE OF A SUBSTITUTE TO H.R. 4355 OFFERED BY MR. BEYER OF VIRGINIA

[Page and line numbers refer to H4355-FC-AINS_01 with timestamp of September 20, 2019, at 4:56 p.m. posted by the Committee on Science, Space, and Technology]

Page 3, after line 8, insert the following (and make such conforming changes as may be necessary):

(2) fundamental research on technical tools for identifying manipulated or synthesized content, such as watermarking systems for generated media;

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

I recognize the gentleman for 5 minutes to explain his amendment.

Mr. BEYER. Thank you, Madam Chair.

Obviously, the potential for serious harm with these deep fakes is quite great in our elections, on an international stage and for diplomatic purposes, and even for our private lives. As a country, we need to take swift action and invest in the research and tools for identifying and combating deep fakes. We need a national strategy immediately, especially for election integrity ahead of the 2020 Presidential election. So I really thank my colleagues and my friend from Ohio for his bill directing the National Science Foundation and NIST to research deep fakes and how we can combat them.

My amendment would simply add one area of research to the National Science Foundation to pursue related to technical tools, especially watermarking, to combat deep fakes. Watermarking technology is essentially an anti-tampering feature built into the image or the code of the image or the video as it comes from a camera. So anytime an adjustment to the original is attempted, it's clear in the file's metadata. And we need more research into this technology to explore its feasibility as a solution for the deep fake identification challenge.

Very little if any research has been done on the watermarking of dangerous deep fake videos, so I urge my colleagues to support this amendment. And I yield back.

Chairwoman JOHNSON. Thank you very much.

Any further discussion on the amendment?

If not, the vote occurs on the amendment.

All in favor, say aye.

Those opposed, say no.

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

The next amendment is the Wexton amendment on the roster and offered by the gentlelady from Virginia, and she's recognized to offer her amendment.

Ms. WEXTON. Thank you, Madam Chair. I have an amendment at the desk.

Chairwoman JOHNSON. The clerk will report the amendment.

The CLERK. Amendment No. 3, amendment to the amendment in the nature of a substitute to H.R. 4355——

[The amendment of Ms. Wexton follows:]

AMENDMENT TO THE AMENDMENT IN THE NATURE OF A SUBSTITUTE TO H.R. 4355 OFFERED BY MS. WEXTON OF VIRGINIA

[Page and line numbers refer to H4355-fc-ains_01 with timestamp of September 20, 2019 at 4:56PM posted by the Committee on Science, Space, and Technology.]

Page 3, line 12, strike "and" at the end.

Page 3, after line 12, insert the following:

(3) research on public understanding and awareness of manipulated and synthesized content, including research on best practices for educating the public to discern authenticity of digital content; and

Page 3, line 13, strike "(3)" and insert "(4)".

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

I recognize the gentlelady for 5 minutes to explain her amendment.

Ms. WEXTON. Thank you, Madam Chair. And thank you, Mr. Gonzalez, for introducing this important legislation, which I am very honored to cosponsor.

As my colleagues have already noted this morning, technology for computer-generated fake content is moving at a speed that is outpacing the tools we have available to detect it. Meanwhile, it's become much easier for bad actors to create manipulated content. The underlying bill will help mitigate those problems, but in addition to developing new technologies, we need to teach Americans how to detect manipulated content that seeks to spread disinformation in the first place.

So my amendment would add language directing the NSF to support research on the public understanding and awareness of deep fake content, as well as best practices for educating the public on how to discern the authenticity of digital content. This is a critical component to our national security deterrent strategy to combat disinformation campaigns because the more education and awareness we have, the better we can strengthen and safeguard our democracy.

I urge my colleagues to support this amendment, and I yield back the balance of my time.

Chairwoman JOHNSON. Thank you.

Any further discussion on the amendment? Mr. Gonzalez.

Mr. GONZALEZ. Thank you. Just quickly, I appreciate my colleague's amendment, both amendments on the bill and their engagement on this important issue. I support the amendment as it strengthens the underlying legislation, and I appreciate the bipartisan nature with which we've gone forward. So I look forward to working with everyone. And with that, I yield back.

Chairwoman JOHNSON. Thank you.

Are there any other comments?

If no, the vote occurs on the amendment.

All in favor, say aye.

Those opposed, nay.

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

We will now vote on the amendment in the nature of a substitute ordered by Mr. Gonzalez, as amended. The vote 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 further amendments?

If no, then a reporting quorum being present, I move that the Committee on Science, Space, and Technology report H.R. 4355, as amended, to the House with the recommendation that the bill be approved.

Those in favor of the motion will signify by saying aye.

Those opposed, nay.

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

Without objection, the motion to reconsider is laid on the table, and I ask unanimous consent that 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 or additional views on the measure.

I want to thank the Members for their attendance this morning. That concludes our markup. The Committee is adjourned.

[Whereupon, at 10:39 a.m., the Committee was adjourned.]

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