

COMMERCE, JUSTICE, SCIENCE, AND RELATED AGENCIES APPROPRIATIONS FOR 2020

HEARINGS BEFORE A SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS HOUSE OF REPRESENTATIVES ONE HUNDRED SIXTEENTH CONGRESS FIRST SESSION

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AND RELATED AGENCIES

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**COMMERCE, JUSTICE, SCIENCE, AND RE-
LATED AGENCIES APPROPRIATIONS FOR
2020**

WEDNESDAY, JULY 24, 2019.

**WHITE HOUSE OFFICE OF SCIENCE AND
TECHNOLOGY POLICY**

WITNESS

**KELVIN DROEGEMEIER, DIRECTOR, WHITE HOUSE OFFICE OF
SCIENCE AND TECHNOLOGY POLICY**

Mr. SERRANO. We would like to welcome Dr. Kelvin Droegemeier, Director of the White House Office of Science and Technology Policy, OSTP, to the subcommittee.

I'm sorry we couldn't give you an audience as big as the other hearing, but I am sure you read——

[Laughter.]

Mr. SERRANO [continuing]. Members of the audience are smiling, the TV cameras are missing, but I am sure that you would rather be here than there, you know.

OSTP is the interagency science and technology policy coordinator across the Federal Government and has a vital role in advising the President with sound scientific and technological advice.

That is a tough job under this administration. Since January 2017, there has been a consistent effort to undermine the Federal agencies that make the United States the world leader in science and technology. In addition, there seems to have been clear attempts to bury the unbiased research and conclusions of the scientists who work for the Federal Government.

Nowhere is that more prominent than in the discussion of climate change. The Trump administration has pursued a relentless agenda of climate change denial. By withdrawing from the Paris Climate Change Agreement, and attempting to bury the stunning conclusions of the Fourth National Climate Assessment, this administration has shown that it is not committed to addressing climate change.

Recently, a State Department intelligence official, Rod Schoonover, spoke before the House Intelligence Committee about the security risks the U.S. faces due to climate change. White House officials refused to allow him to submit a written statement that climate impacts could, quote, "possibly be catastrophic." He ended up resigning from the State Department as a result of this incident.

Tackling climate change is not about scoring political points; it is about confronting an immediate crisis that affects the future of billions of people around the world. We have a moral responsibility to address it now. Only those who close their eyes cannot see the urgent need to act, but those seem to be the very people you need to convince.

Unfortunately, that is not the only scientific controversy in this administration. There are issues involving scientific advisory boards, staffing at your office, and moving the locations of science advisors out of Washington, DC. All of these have an impact on the ability of our Nation to remain a leader in the scientific fields.

This subcommittee is committed to continue to provide the resources necessary to build the workforce of tomorrow, create good-paying jobs at home, and advance scientific progress. In the fiscal year 2020 Commerce, Justice, Science appropriations bill, we provided strong increases in funding for scientific agencies like NSF, NIST, NOAA, and NASA.

In particular, this subcommittee has been very focused on providing robust funding for STEM initiatives, to ensure that young men and women of all backgrounds and geographic locations have access to a STEM education. I have also been particularly focused on fostering greater minority participation in STEM research programs, so that the STEM field fully reflects the great diversity of our Nation.

In addition, this committee, in a bipartisan manner, has dedicated substantial resources to advancing space exploration and maintaining U.S. leadership in space. While I support a continued human presence in space, I remain concerned about the estimated costs in excess of \$20 billion over the next few years to unnecessarily speed up by just 4 years the schedule for returning American astronauts to the Moon. Arbitrarily changing this schedule will have grave consequences for other vital programs across the science fields and other programs across the government.

And I want to just make a point on that. Mr. Aderholt and I are big supporters of NASA, I just disagree with spending this money on moving something up a couple of years. It is not that we oppose going to the Moon; in fact, we are hoping to send some people to stay there, but we won't mention those names right now. [Laughter.]

Mr. SERRANO. Mr. Aderholt and I may disagree again. But we are big supporters and we intend to continue to work on that together.

Thank you, once again, Director, for joining us today, and I look forward to hearing your testimony.

I would like to recognize at this time the aforementioned Mr. Aderholt.

Mr. ADERHOLT. Thank you for yielding, Mr. Chairman. And, now we have marked up the Commerce, Justice, Science bill for fiscal year 2020 and it awaits further action, it is important for the committee to hold these oversight hearings, and better understand our agencies and programs under our jurisdiction. And, of course, that is no other better than to have this hearing today with the White House Office of Science and Technology Policy.

Like the chairman, I would also like to welcome you to the subcommittee, Mr. Droegemeier. And thank you for joining us this morning, as the chairman mentioned, to talk about the important work of the White House Office of Science and Technology Policy, the fiscal year 2020 budget request, and also the Administration's research and development priorities.

If I understand it correctly, you are the first meteorologist to lead the White House Office of Science and Technology Policy. And as someone with a very strong interest in the weather and coming from an area of the country that is prone to catastrophic tornadoes, I am very interested to learn how your career and the extreme weather events, how it shapes the vital work you perform at OSTP.

As the Director of OSTP, you have a very important job. Not only do you formulate Federal R&D budgets and advise the White House on such critical issues as quantum information science, 5G, and STEM education initiatives, but under your leadership OSTP coordinates all science and technology policy across the entire Federal Government. OSTP ensures that the United States is pursuing the most effective interagency research initiative and investing in cutting-edge industries, like artificial intelligence and advanced manufacturing, to ensure that we are equipped to continue leading the world in science and technology, and that we are not falling behind our competitors, for example, like China.

Here, on this committee, Commerce, Justice, Science Subcommittee of Appropriations, we have a long history of bipartisan support for investment in fundamental science research. And, from time to time, we may disagree on how we fund it and how to spend the best, as the chairman indicated, and that may be the case, but our members on both sides of the aisle recognize that research investment spurs innovation and innovation drives the economy, it strengthens national security, and ensures that the United States remains the global leader in technology advancement.

And to ensure that the United States stays on that cutting edge of technology, and remains competitive well into the future and for future generations, we must continue to invest in our Nation's students and in the STEM education programs.

The fiscal year 2020 budget request, the House passed funding mark for the Office of Science and Technology Policy, of course, is \$5 million. Our goal today is really try to better understand how this funding enables you at OSTP to continue science initiatives to build our Nation's initiatives for the future, pursue emerging technologies, and ensure that the United States remains the world leader in innovative research and also in technology.

With that, I look forward to your testimony this morning and the thoughtful discussion that we will have ahead of us.

So, thank you, Mr. Chairman, for organizing this important hearing, and I yield back.

Mr. SERRANO. Thank you, Mr. Aderholt.

Director Droegemeier, the plan is for you to make a 5-minute statement. Your full statement will go in the record. And after that, we will open up to questions under a strict 5-minute rule. Sir.

Dr. DROEGEMEIER. Very good. Good morning, everyone.

Chairman Serrano, Ranking Member Aderholt, distinguished members of the committee. It is truly my great honor to be here

to testify as Director of the White House Office of Science and Technology Policy. I look forward to discussing our priorities at OSTP, our vision for science and technology in America, the fiscal year 2020 budget, and of course your questions.

Now, as you know, last week marked the 50th anniversary of the Apollo 11 Mission that landed the first man on the Moon. This landmark achievement captured the attention of the entire world and also sparked the scientific curiosity of every American.

Now, a half a century later, our Nation has entered a new, bold era in science and technology, and one that truly leverages our uniquely American capabilities.

They are, first, substantial Federal Government funding of basic and applied research; second, private companies that collectively invest about \$380 billion per year in research and development; third, a post-secondary education system that boasts some of the best research universities in the world; fourth, non-profit organizations that invest tens of billions of dollars per year in research; and, finally, a system of National and Federal laboratories that are without equal anywhere on Earth.

From all of these sectors combined have come breakthroughs in medicine and physics, and engineering and biology, and many other fields that allow us to tackle the greatest challenges of our time and to help Americans live healthier, safer, and more prosperous lives.

Now, as a university educator who has dedicated his entire career to research, I truly believe in my heart there has never been a better or more exciting time to be involved in research than right now, right here in America. Since my confirmation hearing last January, I have focused OSTP's efforts on strengthening America's global leadership in science and technology. And that means, among many other things, ensuring that environments in which research is performed are set up to foster discovery and innovation.

Toward that particular end, in May the National Science and Technology Council, which actually sits within OSTP and which I have the privilege of chairing on behalf of the President, launched something we call the Joint Committee on Research Environments, or JCORE.

JCORE's mission is to ensure that America's research environments—and by that I mean the laboratory, the classroom, the studio, the field, wherever research is done—upholds the highest standards of integrity, ethics, and safety; that these environments foster diversity, they promote productivity, they are free from harassment, and they serve as a model to the world by reflecting our core American values.

JCORE's four subcommittees address the following four issues: research security, safe and inclusive research environments, rigor and integrity in research, and reducing research administrative burdens.

Now, although JCORE is a priority for OSTP, a wealth of other exciting work is underway that touches many, many critical areas I know that are of interest to you. To give you a sense of that portfolio, we have made incredible progress in supporting American leadership in Industries of the Future, as we heard, advancing ocean science and technology, enhancing our Nation's space weath-

er preparedness, promoting our vibrant bioeconomy, and strengthening partnerships within government and the other sectors that I mentioned.

As OSTP Director, I have placed strong emphasis on STEM education, enhancing diversity, and also on workforce development. We believe, and I believe personally, that Americans of all backgrounds should have access to STEM education and skills, with special attention to lifelong learning, to nontraditional educational pathways into the skilled technical workforce. In fact, OSTP released a national strategy for STEM education last winter and we are now taking steps to coordinate its implementation.

Another important core duty of OSTP's is to assist the Nation in setting R&D priorities for our Federal agencies. In collaboration with the Office of Management and Budget, we are currently in the process of developing the fiscal year 2021 Budget Priorities Memo, which is set for release later this summer.

The Administration's fiscal year 2020 proposed budget for research and development put forward a robust vision for strategic investment in Industries of the Future, in the security of the American people, while also supporting basic R&D across the Federal Government enterprise. Central to that approach is a commitment to responsible stewardship of taxpayer dollars, adherence to statutory budget caps, and recognition that we must fully and effectively leverage our entire multi-sector R&D ecosystem.

And, finally, let me add that it is my personal great privilege to lead a very talented and very diverse staff at OSTP. This office features some of our Nation's foremost leaders in artificial intelligence, and ocean science and neuroscience, medical science, quantum computing, and many, many other fields.

We are making extraordinary progress to advance America's science and technology leadership, and I am really, really proud to be here to share it with you today. And I truly, in the months coming forward, look forward to working with you, and I very much appreciate the opportunity that you give me to testify today and to collaborate with you in the future.

Thank you very much and I look forward to your questions. Thank you, sir.

Mr. SERRANO. I am tempted to make the first question, can you tell us what the weather is going to be this weekend, but—

[Laughter.]

Dr. DROEGEMEIER. That is an easy one. I hope the rest of them are easy. It is going to be—well, it is clear and sunny, which to me is not nice weather. I like storms, I like rain, I like wind. And I don't like tornadoes so much, but I like to see the weather in action. So clear skies, summertime is so boring for me, but it is going to be nice, if that is how you define nice, yes.

Mr. SERRANO. Okay. I'm almost sorry I asked. [Laughter.]

Mr. SERRANO. But not sorry. In your opinion as a scientist, do you believe that the Earth's climate is changing due to increased levels of carbon dioxide as a result of human activities?

Dr. DROEGEMEIER. Yes, sir. And I would like to answer that question by asking another question rhetorically and that is, are we doing the best we can to provide the kinds of guidance that the

lawmakers and the Administration really needs to make major decisions about the climate 100 years from now.

And so now comes the answer to your question—and the answer to the question I posed, I think, is no—but what we do understand is this, that greenhouse gases are increasing with time. We do see that the Earth's average global temperature is warming. And the question is, what is the connection between the two? And there is a very strong connection. In fact, we have strong evidence from isotopic analysis of carbon, and so on and so forth, that the increase that we have seen in the last 70 to 100 years of the global mean temperature is predominantly due to human cause or so-called anthropogenic effects.

And by analogy I would say, do you remember the days back in the Cold War when sniffer planes would go out and sort of, you know, try to see if somebody had done an underground nuclear explosion. And they would sort of capture material in the air and say, okay, that particular isotope of, say, you know, uranium could only have happened if in fact there was an explosion of an atomic device.

That is the sort of evidence—there are many, many other lines of evidence that we have, but that is the kind of evidence that we have that links the increase that we are seeing in global temperatures with the greenhouse gas emissions.

Mr. SERRANO. So, but you said no to the answer and then you gave us a lot of reasons why it is a yes. It is a little confusing, though I must say, to me at least.

Dr. DROEGEMEIER. Yes, sir. Thank you, and I appreciate the opportunity to clarify. So my question was, are we doing the best we can? And my answer to that was, no.

So what I just mentioned is the facts as we see them and we understand those facts based on our physical understanding of how the atmosphere works. And the climate models that we have, even simple theories, are what really back that up and say, yes, we know why the increase of temperature should be higher over land and ice, why the ocean should be getting warmer, why they should be getting more acidic, and things like that, some of the basic understandings. What we don't understand is how those effects at the global scale translate down to local and regional effects, which themselves can in turn affect the larger scales.

And so that is where—and if you want me to elaborate, I can—where we really, I think, have more work to do to really provide informed judgments about what the climate system will look like 100 years from now.

Mr. SERRANO. Good. Now, the Presidential Committee on Climate Security is led by a well-known climate science denier, Will Happer, who disputes the overwhelming consensus of climate scientists. Emails obtained from a request show that Happer pressured NASA to alter or eliminate climate change references on NASA websites, something NASA has not done. It would appear that the role of this Presidential Committee is to attack scientific findings.

To what extent does your office take direction from the Presidential Committee on Climate Security?

Dr. DROEGEMEIER. Well, actually, sir, the reporting in the press has been incorrect: there is no such committee at this time, no such committee exists.

Mr. SERRANO. No committee exists?

Dr. DROEGEMEIER. That is correct.

Mr. SERRANO. So you are the only one in town, so to speak?

Dr. DROEGEMEIER. Well, a lot of folks advise the President, rightly so, on matters of science policy. I am not the only one, there are a lot of great folks, depending on what the particular topic is, but no such committee has been established at this point.

Mr. SERRANO. So you are saying for the record that the Presidential Committee on Climate Security does not exist?

Dr. DROEGEMEIER. That is correct.

Mr. SERRANO. Very interesting. Well, then that throws out like half of my questions here.

Can you walk us through the process of an agency or department getting statements to Congress approved?

Dr. DROEGEMEIER. There is a process, a so-called clearance process, that is used in the White House complex. It depends on the topic in terms of what so-called EOP components, Executive Office of the President components actually get that. If it is something to do with science, you know, we will get it, if it is something to do with domestic policy, maybe other folks get it.

So not everybody sees everything and, if they did, they wouldn't be able to do their regular job. So it just depends on the topic and there is a process that plays out to get a lot of input on whatever the issue is and whatever the document is right.

Mr. SERRANO. Are you aware of any formal or informal guidance regarding the editing of reports or congressional testimony with respect to climate change?

Dr. DROEGEMEIER. I believe that some of those things go through a clearance process. Sometimes at the agencies, sometimes we don't see them. If it is something within an agency, typically we wouldn't see that. It is only, for example, if it is coming out of the White House.

So, again, the process depends upon the nature of the activity or the document.

Mr. SERRANO. So there might be clearance at the White House that you don't know about, is that—

Dr. DROEGEMEIER. That is correct, that is correct. Right.

Mr. SERRANO. And at the agency that you don't have to know about or—

Dr. DROEGEMEIER. That is correct. We do communicate with agencies and collaborate. We have got wonderful relationships with them, but, you know, we are not involved in a lot of the minutia, the various things that they do, and sometimes they ask and sometimes they just do their thing.

Mr. SERRANO. My time is up.

Mr. Aderholt.

Mr. ADERHOLT. Thank you.

Last month, the National Science and Technology Council released an update to the National Artificial Intelligence Research and Development Strategic Plan, which focused on eight strategic priorities, and those included the making long-term investments in

artificial intelligence research; gaining a better understanding of ethical, legal, and societal implications of artificial intelligence; and a new focus on expanding public-private partnerships to accelerate the advancement of artificial intelligence.

The question would be, what is the Administration's priorities for implementing this updated artificial intelligence plan, and how is the plan likely to impact future budget requests in this type of research and development for the funding?

Dr. DROEGEMEIER. Thank you, sir, for that question.

I think, as you all know, artificial intelligence is extraordinarily important for the future. It is one of the so-called industries of the future that was highlighted in the President's budget this year, he mentioned it in his State of the Union address. The others are advanced manufacturing, quantum information science, and I think synthetic biology and 5G wireless technology. So those are what we kind of collectively call industries of the future.

The AI Initiative, the American AI Initiative the President signed the Executive Order for on February 11th—I remember it well, because it was the day I got sworn in ceremonially by the Vice President—has three pieces to it: R&D, workforce development, and then also the regulatory framework.

So what Mr. Aderholt just mentioned, what came out just last month was the update to the R&D strategic plan. So that is kind of the R&D piece of that. And there are, as you say, seven or eight different strategies.

First of all, the important thing to note is that OSTP really helps coordinate, as we heard earlier from you and the chairman, coordinate across the Government in terms of the interagency; that is what the National Science and Technology Council does. And we have in the context of artificial intelligence a special committee, we call it a select committee, which involves the agency heads themselves. Sometimes subcommittees are, you know, agency folks, but these are actually the agency heads, which is a testimony to the importance of AI.

So part of what we do in that role is to make sure that the agency budgets and budget planning align with the strategic goals that you just mentioned. And so there was actually a data call issued not long ago to the agencies to look at how they are spending their money, because one of the things that is difficult is, how do you define AI? You know, AI is software, it is hardware, it is all kinds of things.

And so in the John McCain National Defense Authorization Act that was signed, I believe, a year or two ago, it actually put out a formal definition, which is now in law, about AI. So we are kind of following that definition and that is guidance to the agencies about how much are you really spending. So in the non-DOD, non-classified area, it is about a billion dollars a year, and so it encompasses lots and lots of things.

So part of the answer to your question is, in this role of the NSTC subcommittee—or select committee, I should say, you know, help the agencies determine how to direct that funding, how to make sure that it invests commensurate with the plan.

For example, NSF, in working with the agencies, they fund a lot of research into ethics of AI, because the regulatory framework is

extremely important, there is a lot of work going on. DARPA, the Defense Advanced Research Project Agency, funds work in explainable AI. Okay, AI is telling you this is the answer, how do you know it is right? It might be statistically unbiased, it might be socially incredibly biased. How do we deal with those differences? So there is a lot of important work and a lot of questions.

And then, finally, the partnerships that you mentioned, sir, are a really critical part of my personal agenda coming into OSTP. We talk a lot about partnerships as kind of a throwaway word, but, frankly, in America we don't do nearly as well with partnerships as we really could. So that is something that we are diving very deeply in. And by partnerships I mean agencies and private companies, private companies and universities, at the institutional level, at the individual researcher level.

And those four sectors I mentioned—the private sector, the government sector, the nonprofits, and the universities—if we bring those together more effectively, we will get so much more out of our enterprise than what we are getting now. So I would say we have a V8 engine maybe running on six cylinders; when we get those other two cylinders going through partnerships, we will be able to really do some extraordinary things. There are wonderful partnerships out there, I don't want to suggest there aren't, but we can do even more, and that is part of the AI plan.

Mr. ADERHOLT. So what is the amount of spending on the unclassified AI research alone, did you say—

Dr. DROEGEMEIER. Well, so the unclassified includes Department of Defense. The numbers that we have right now are the unclassified—excluding the unclassified—excuse me, excluding the classified and excluding the Department of Defense. So, with those two exclusions, it is about \$1 billion a year across the—

Mr. ADERHOLT. So \$1 billion. Okay.

Dr. DROEGEMEIER. Yes, sir.

Mr. ADERHOLT. And you have talked a little bit about it, but how is OSTP tackling the challenges in defining artificial intelligence so that we can effectively track the Government's efforts?

Dr. DROEGEMEIER. Right. So right now we are using the definition that was in the Defense Authorization Act that was a couple years, the John McCain Act.

Mr. ADERHOLT. John McCain.

Dr. DROEGEMEIER. And that is kind of the working definition now. There is opportunity, I think, to tweak that as we learn more and things progress, but that is the working definition at the moment.

Mr. ADERHOLT. Okay. Thank you, Mr. Chairman.

Dr. DROEGEMEIER. Yes, sir.

Mr. SERRANO. Mr. Cartwright.

Mr. CARTWRIGHT. Thank you, Mr. Chairman. And welcome, Director Droegemeier.

Dr. DROEGEMEIER. Thank you, sir.

Mr. CARTWRIGHT. Congratulations on your nomination and confirmation to the position of Director of OSTP. There was a 2-year vacancy after Dr. John Holdren and one thing I wanted to ask off the bat was—obviously, big shoes to fill—have you had a chance to consult with Dr. Holdren over the years?

Dr. DROEGEMEIER. I have. And I have worked with John, he is a good friend of mine. I have the highest respect for him; I think he did a wonderful job leading OSTP.

Mr. CARTWRIGHT. I feel the same way and I wish you all the best luck.

Dr. DROEGEMEIER. Thank you.

Mr. CARTWRIGHT. Now, I was glad to see the broad support for your nomination. I was particularly heartened by some of your comments over the years, particularly in your confirmation hearing when you said integrity in science is everything, and you said science has to lead the way in telling us what the facts are, and that you agree with—as you said today, you agree with the overwhelming consensus among scientists that global warming is strongly connected to human activity, as you say, anthropogenic—I can't even say that—but I congratulate you not only for saying it, but for repeating it here in committee.

Here is my question. In June 2017, you and Dr. Daniel Reed wrote an opinion article published in the Des Moines Register regarding science and research funding in the fiscal year 2018 budget, and in that article you argue against cuts; cuts to science, cuts to research funding. You implore the White House and Congress to work in a bipartisan manner to preserve the Federal investment in basic research that has long enjoyed bipartisan support.

You stated, quote, “Though the benefits of short-term savings in the yearly Federal budgets may appear appealing, they result in insidious, long-term consequences. Due to under-funding, we risk losing an entire generation of researchers who produce these miracles when we need them most. Rebounding from the loss of talent is neither immediate nor inexpensive,” unquote.

Did you say that?

Dr. DROEGEMEIER. I believe so.

Mr. CARTWRIGHT. Good line. The article highlighted the important role scientific research plays on economic development by citing the fact that, since World War II, science and technology have been responsible for more than half of U.S. economic growth. In fact, you said, quote, “Addressing massive Federal debt and deficits depends in part on our ability to grow the economy by creating and innovating entirely new technologies and services that all begins with research,” unquote.

Did you say that?

Dr. DROEGEMEIER. I believe so, yes, sir.

Mr. CARTWRIGHT. Good. But we fast forward, Doctor, to March of this year and the President's fiscal year 2020 budget, which was an all-out assault on scientific research in this country. You issued a statement calling the budget request, quote, “an important down payment on America's future,” unquote, that, quote, “promotes responsible spending by prioritizing high-impact programs that have been shown to be effective,” unquote.

Now, this Congress and, specifically, this subcommittee here in this room rejected the President's gutting of scientific research, but I think it is important to highlight the list of requests we got in the President's budget this year that would have cut federally-supported scientific research.

We start with the NASA budget. He wanted it cut by 2.2 percent with an 8 percent drop in science portfolio; he wanted an 11-percent reduction in overall R&D; he wanted a 12 percent reduction in the National Science Foundation; he wanted an overall cut to the National Institutes of Health by 13 percent; he wanted a 15-percent cut in the National Cancer Institute; he wanted a 17-percent cut in the Department of Energy, Office of Science budget; he wanted a 30-percent cut in the National Institute of Standards and Technology, NIST, 30 percent; he wanted a one-third cut overall to the Environmental Protection Agency, including a nearly 40-percent cut in its science and technology programs; and he wanted an 86-percent cut in the Department of Energy, Office of Energy Efficiency and Renewable Energy. All of that came over to us in the budget this year.

Question: did you provide any guidance to the President regarding these significant cuts to funding science and technology across the Federal budget?

Dr. DROEGEMEIER. No, sir, I didn't. That budget was already in place when I arrived and got sworn in in January. Yes, sir.

Mr. CARTWRIGHT. Thank you, Doctor.

Dr. DROEGEMEIER. Thank you.

Mr. CARTWRIGHT. I yield back.

Mr. SERRANO. Mr. Palazzo.

Mr. PALAZZO. Thank you, Mr. Chairman. And thank you, Director Droegemeier, for being here today.

I want to speak with you today about STEM engagement, particularly those programs geared towards workforce education and training. Federal agencies should prioritize initiatives to re-skill Americans for the present and future job market, and since taking office President Trump has worked to improve STEM education and increase STEM employment.

How are you planning to provide STEM-filled opportunities for Americans of all ages in both rural and urban areas? And can you also discuss how the 2020 budget request affects the implementation of the 2018 Strategic Plan for STEM Education?

Dr. DROEGEMEIER. Absolutely. Thank you for that question.

As a STEM educator my whole career, STEM is very important to me. I also was the Cabinet Secretary of Science and Technology in Governor Fallin's cabinet in Oklahoma and STEM was a big deal there, and I keynoted some of her STEM conferences and so on. So STEM is really, extraordinarily important to me personally. It is the future of our economy, frankly, in so many different ways.

And coming from a so-called EPSCoR state, I think most of you know what EPSCoR is, you know, I am all about making sure everybody, as I mentioned in my opening statement, has access to opportunity.

This Government invests about \$3 billion a year in STEM education programs. That is not just STEM education and research, but it is also programs that support after-school learning and things like that. There are some 160 different programs that are doing really extraordinary things, but I kind of characterize it as we are planting a lot of flowers, a thousand flowers are blooming, but I think we need to look at planning some really lush, wonderful

gardens and having more connective tissue among those various programs. So that is one of the things that we are looking to do.

With regard specifically to this Administration, last December we released a 5-year STEM Strategic Plan for the Nation. And it was truly an extraordinary plan in the sense that it wasn't just the Government sitting down and saying, what should we do, it actually convened the entire Nation of stakeholders, about three to four people from every state and territory. So about 180 people came to Washington—teachers, superintendents, principals, things like that, and even some folks in the private sector who do other kinds of learning and up-skilling like robotics competitions and so on—we got together and we said, as a nation, where do we want to go in STEM?

And it was really an extraordinary conversation that led to this report, which we kind of see as a Northstar report. And I think it is frankly one of the best STEM reports that we have seen, because everyone that attended that and everyone who is involved in STEM education will see themselves in that plan. And it has got three pillars: one is the STEM workforce of the future; the other one is a STEM-literate society, which we all know is extremely important; the third one is really critical and that is diversity enhancement. So one of the three pillars is diversity enhancement.

With regard to the skilled technical workforce, let me define what I mean by that term. It means folks who are beyond high school, but below the baccalaureate level. So they might have 2-year college, they might have a skilled training in say a career tech or something like that. There has been a very strong focus on those folks here in the Administration. Ivanka Trump has pledged to the American worker and there are now around 11 million people to be up-skilled and re-skilled through pledges made by private companies. Truly extraordinary.

We are working on veterans, using data and analytics, and machine learning and AI, to help veterans as they separate from the service to get on pathways beyond what the simple job description they came out of the military with. Okay, I did this. Well, if you did that, it turns out you did five other things you are not even aware of.

The other important thing, I think, is that we want to make sure that we don't forget about the importance of these. When we look at the—you all saw the picture of the black hole, the image there and things, there were a lot of people who were involved in managing those telescopes, building the instrumentation. They may not have a college degree, but they are extremely important. People who are welders, who build cryogenic tanks and things like that. So they kind of go unnoticed a lot of times in these great scientific discoveries, but without the skilled technical workforce, we would be in a world of hurt.

So there is a huge focus in the Administration, and the actual Science Board as well, looking at the skilled technical workforce and how we make sure that we have the totality across STEM—and I call it seamless STEM—from PhD all the way to high school, we have got to have all those workers engaged from every part of the country, every zip code. Nobody is left behind, we have got to

bring them all to the table, because the problems we have to solve are so immense that it is an all-hands-on-deck proposition.

Mr. PALAZZO. Thank you for that response.

In your testimony, you also speak of OSTP's work with advance in ocean science and technology. Could you please expand on that valuable work?

Dr. DROEGEMEIER. Sure, absolutely. The President has been very, very strong on ocean policy. He signed an Executive Order that created the Ocean Policy Committee, the OPC, which I have the privilege of co-chairing with Mary Neumayr, the chairman of the Council on Environmental Quality. There are a lot of things going on. We have a Decadal Ocean Vision now, we have a strategic plan. There is a National Ocean Partnership Program, there are regional ocean partnerships. There is work on harmful algal blooms in the midst of that, there is work on mapping the Extended Economic Zone—I think it is called the Exclusive Economic Zone, which is a huge area of the United States you don't think about because it is under water—in terms of things like energy and fishing, and quality of life and recreation, and so on.

Plastics, marine debris, is a huge thing. And we are going to be holding a Science and Technology Summit, I think it is in probably November-December of this year, to bring together private sector, nonprofits, government, universities. To talk about these compelling problems and, back to the word "partnership," how in partnership we can solve these together.

So the ocean enterprise is really, extraordinarily vibrant in the Trump administration, I think we are making very good progress, and not only just in oceans, but things like harmful algal blooms for the Great Lakes and Florida, and some of the coastal regions that are subject to these very, very difficult challenges.

Mr. PALAZZO. Thank you for your testimony.

Dr. DROEGEMEIER. Yes, sir.

Mr. SERRANO. Ms. Meng.

Ms. MENG. Thank you, Mr. Chairman. Thank you, Doctor, for being here today.

I wanted to follow up with what Mr. Palazzo was talking in terms of STEM. To maintain U.S. leadership in science and technology, we must ensure the ecosystem of universities, nonprofits, industry, can attract and support the best talent. I know that this May the White House formed this new joint committee to boost support for research committees that you are leading. And I wanted to know, more specifically, how is this joint committee working with industry? And also how is it working with the higher education community and what more can Congress probably help with?

Dr. DROEGEMEIER. Thank you. That is a really great question and such an important one. And, frankly, this is really, I would say, among my highest priorities is this new joint committee, because as a researcher, as a former vice president for research, I lived in the midst of those research environments and I saw a lot of things happening, as I have certainly talked to a lot of people over my career, of things where I feel the research environment has got to be right. If women don't feel comfortable coming into it, if they are in it and they leave, that is really, really, really bad news.

Our environments have to reflect our American values and, frankly, we hear people talk about Safe Spaces. I dream of the day and believe we can make it happen, and certainly, with your help, as you have just mentioned, where the research environment is the place people run to, because that is where their ideas are respected; that is where they are treated well; that is where they can vigorously debate and walk away and go to dinner and be complete friends; where we really saw the tough challenges and no ideas beyond being able to be discussed. That is the environment I believe we have and that is attainable.

With regard to STEM, it is extremely important, especially that these environments are effective. So this National Science and Technology Council, as we heard, is the organization that coordinates the intergovernmental activities. Research security is one of them, which we can talk about. I want to make sure I answer your question. Another one is issues of things like inclusiveness and safety, a/k/a sexual harassment, we need to make sure those issues are addressed. It is a cultural change, it is not going to be easy, but it is critical, I think.

Another one is rigor and integrity in research. And then another one, which is really important in terms of budgets, is research administrative burden, which is now after the past 20 or so years is not going down, it roughly is the same steady state for the last 20 years, about 40 to 45 percent of faculty researcher time spent on Federal grants is spent on doing compliance activities that are in many ways unrelated to the research. Some of that compliance is very important, but 44, 45 percent is an awfully big number.

Ms. MENG. Thank you. And you talk about administrative burdens. I know that—or I have heard that are often diverse sets of rules with DOE, NIH, NSF, are there plans to sort of standardize and make more uniform these sets of rules?

Dr. DROEGEMEIER. You are absolutely right. And actually one of the easiest things that we can do, among many, is to what we call harmonize or standardize those things to the extent possible. Now, some agencies are different, but I think at the top level we have got to have this standardization. So if you're writing a research proposal and every agency, as you mentioned, uses a different form, uses a different form for what work you are already doing for your biographical sketch. I all of those are different, you are spending massive amounts of time not undoing science, but on dealing with these kinds of non-uniformities.

So we have an entire list of things. And the Federal Demonstration Partnership, which it says it is Federal, it is National Academies and it's the university and it's the Federal Government. I have gotten together over the years to say what do we need to do? And, frankly, we are not making nearly as much progress as we need to, because I can't think of anything worse than a research who spent a lot of time and money becoming an expert and then not using that intellectual talent to do science. So this is really a top priority and we have a whole lost of things that we are going down, sort of knocking down one by one, and the harmonization is one of the most easy, I think, to address and one of the most important.

Ms. MENG. Is there a sort of time line for—

Dr. DROEGEMEIER. Fast, fast, fast. You know, I think in the last several years, like I said, with the latest survey that just came out, the numbers are no different, and we have got to solve this. I would sort of be reluctant to monetize it, but some people have, they said it is two to \$3 billion of lost capacity that we could get back if we address some of these issues. So, to me, it is an imperative for a variety of reasons, but especially for making sure that we do lead the world in science and technology.

Ms. MENG. And I just want to end with a comment. I thank you for addressing the issue of sexual harassment and gender discrimination in this scientific space. I just want to make sure that as you are undertaking on this topic, that individuals who are reporting this sort of harassment, that they are protected, their privacy, by the Federal Government.

Dr. DROEGEMEIER. Absolutely right. It is a complicated set of issues that gets into Title IX and things like that, but it is extraordinarily important, because if people don't feel comfortable coming to the research environment, the rest of it doesn't matter, because we might educate a lot of researchers, but if the environment is wrong, they are not going to come into it and then we lose. And we lose the trust of the taxpayer and the tremendous social contract we have with taxpayers that entrust us to spend these dollars wisely.

Ms. MENG. Thank you. I yield back.

Dr. DROEGEMEIER. Thank you.

Mr. SERRANO. Mrs. Lawrence.

Mrs. LAWRENCE. Thank you, Mr. Chairman.

I want to thank you, sir, for coming here today to testify. The Subcommittee on Machine Learning and AI, called MLAI subcommittee, was formed by the President Obama administration and renewed by the Trump administration. Now, outlined in function number 6, it states that the subcommittee will publish and update a strategic plan for unclassified MLAI research and development.

Are you aware of these reports and, if so, is there a way that OSTP can share these reports with Congress? I strongly believe that these reports will be able to provide a great deal of guidance to Congress as we work to appropriate funds for AI R&D.

Dr. DROEGEMEIER. Yes. Thank you for that good question. I have a list here of all the reports and we have got a whole big spreadsheet that says, you know, what the target date is and so on, and these are all public reports, so we would be delighted to share them with you.

Mrs. LAWRENCE. Okay.

Dr. DROEGEMEIER. Yes.

Mrs. LAWRENCE. Well, through the chair, I would hope that that would happen.

You know AI, the AI Now Institute based out of New York University, released a report in April of 2019 entitled, "Discriminating systems: Gender, Race, and Power in AI." Their findings show that we have a severe diversity crisis in the AI sector across gender and race. The report stated that "fixing the pipeline won't fix AI's diversity problems."

I know the diversity, inclusion, safety, and security of our researchers in the R&D enterprise is an issue that is very important to you. How do we tackle this issue? And this is becoming a very increasing level of concern, as people are unfamiliar with AI and we hear how it can impact minorities and people of color.

So, could you please comment on that?

Dr. DROEGEMEIER. Oh, thank you, that is a marvelous question. So you are not asking about the people pipeline, you are asking about AI itself; right?

Mrs. LAWRENCE. AI itself.

Dr. DROEGEMEIER. Right. So it is a really, really important point you bring up, and as I mentioned, there is a lot of work going on now in terms of the ethics of AI and the explainability and so on.

The key thing here is sort of twofold. One is the actual algorithms, and the second thing is the data with which these systems are trained. And frankly, if you are training it with biased data, then the results you are going to get are biased. And I also would like to say that statistically, we could say okay, this result is unbiased, but that doesn't mean it is socially unbiased. Excuse me. Let me say that again and make sure I said it right.

It could be statistically unbiased, but socially biased. That is what I want to say.

Mrs. LAWRENCE. Exactly.

Dr. DROEGEMEIER. And we have got to figure that out because that—you know, the social bias versus statistical, that could be a pretty wide gulf, and how do we navigate that. So a lot of work is being invested, a lot of time is being invested in studying these things in the university system. It is part of the conversation as we go through this whole thing.

We signed on with 41 other nations on a set of AI principles in the OECD countries, the Organization of Economic Cooperation and Development, earlier this year. So that helped set the framework. But ultimately, it is the R&D that needs to be done to make sure that we understand the training aspects, the algorithms themselves. And then once those are in place, how do we know where the bias is happening, if it is bias, and how do we judge that.

So you bring up an extraordinarily important point that a lot of folks are working on, but we can't let down our vigilance to make sure that at every step of the way that we are no top of that.

Mrs. LAWRENCE. I feel very strongly that we should, and as part of our civil rights and as part of our expectations of equality in America, that we, as Congress, need to have an ethical standard when it comes to diversity and inclusion, because if we don't establish that, how do we understand or how do we regulate that biases are not being programmed into AI.

The last question that—

Dr. DROEGEMEIER. Could I just ask—

Mrs. LAWRENCE. Yes.

Dr. DROEGEMEIER. When we talk about, you know, the research environment, I would love to work with you on that because part of the thing is how do you define these things. And if you are in the middle of research environment and there is harassment and things like that, how do you recognize it and how do you define it?

So I would very much enjoy working with you on that. I think there is some overlap that we could benefit by talking.

Mrs. LAWRENCE. Absolutely.

Dr. DROEGEMEIER. Thank you.

Mrs. LAWRENCE. And the last thing I would say, the NIST released standards for trustworthy AI, and I strongly believe that we need a comprehensive understanding of the current uses and the risks. And I want to make sure that, and you have said that, that we are creating standards and that we also are recognizing the risk in AI research.

Dr. DROEGEMEIER. Absolutely. And I would hasten to add that my colleague, Michael Kratsios, who right now is testifying before the Senate Commerce Committee to be confirmed, hopefully, as the chief technology officer, has been doing extraordinary work and he leads our tech portfolio, and he is a phenomenal person. We have engaged—somebody asked me earlier and I forgot to mention this, we have engaged industry very, very strongly and heavily on this whole AI portfolio, industry, academia, and government, they are all at the table.

And so absolutely. And Michael and I will work very closely together on that and I assure you that we will give it full attention. Thank you so much for that point.

Mrs. LAWRENCE. Thank you, and I yield back.

Mr. CASE. Thank you, Doctor. You know, of all of the billions, and billions, and billions of dollars we authorize for scientific and technology research and advancement for—just for basic science and research advancement for, you know, economic and social good, and purposes, and for our own policy guidance, I think nothing concerns me more than politics getting into the middle of all of that. Then political goals coming to bear on influencing what is researched, influencing the outcome of that research, and suppressing the outcome where—inconsistent with the goals.

And you are well aware that claims have been made in that department from the perspective of climate change, or from the perspective of, you know, women's health in the terms of the great and continuing abortion debate, and in many other areas. You know, one example of that would be the Union of Concerned Scientists, which a couple of years ago claimed that Director of the Interior had suppressed a report on health conditions in Appalachia from surface coal mining, presumably because he did not want to call into question those operations. And we have spent a great deal of time over the years, trying to assure scientific integrity.

We have a GAO process that goes back ten plus years now. We have the previous administration asking for scientific integrity principles and guidelines and requirements, really, to be adopted across the entire federal government. We have a GAO report from just a couple of months ago, April, which was followed up on just a month ago, in which the GAO essentially said that the scientific integrity guidelines and principles had been inconsistently applied across the administration. And the basic complaint that GAO had was that in these various departments, there was not a sufficient education and enforcement component to really drive home the point that scientists are free to do their research and to insulate them from these pressures.

And I think you are in charge, in large part, of assuring that scientific integrity effort across the entire administration. And so I simply want to ask you, is this a concern of yours? Where do you rank it in terms of the concerns? And what are you doing about it?

Dr. DROEGEMEIER. Right. Yes, thank you. No. Very, very good question. So in my confirmation hearing last August 23rd, that question was put to me in a similar way, and I said without equivocation that I strongly support ethical behavior and research that, I think, science has to be conducted in the federal government, I would say, for example, which is what I think you are talking about, in an unfettered way without political influence. I think that is extraordinarily important. You cannot have political influence determining scientific outcomes, scientific directions, and things like that.

The GAO report, I read that. There were nine—I think nine agencies that were evaluated and so on. And I think as you also alluded to, the 2010 memo from my predecessor, John Holdren, asked agencies to put forward their plans to OSDP and so on. The subcommittee I mentioned in the JCORE, this Joint Committee on Research Environments, has a subcommittee on research integrity and ethics, ethical behavior, robust. It also gets to things like reproducibility, which is different from integrity, but it is related to it and can be.

In JCORE, we looked at this issue and talked about it of the issues of which you speak and said, well, the GAO report—at that time, GAO was doing its thing. We weren't sure when the report was going to come out. So we said we are really going to focus on the research process itself and not the political piece that you mention. But that is of great importance. I think it is important to the taxpayer to ensure that they know that our government is functioning with the utmost integrity as it conducts science and so on. So you are right.

We do have a role to play. I think we were going to wait and see how—give agencies a time to respond to the GAO report, which would take a few months and so on, and then sort of see where we are with that. I could easily envision at some point appropriately down the road, after I have a chance to respond, that this JCORE group could serve as the mechanism to address the kinds of—sort of update the things you are talking about.

Mr. CASE. And Congress has also taken an interest through the introduction of legislation, for example, the Scientific Integrity Act which is introduced by my colleague Paul Tonko on the House side and my colleague Senator Schatz on the Senate side, has a number of close sponsors, including myself, to express this specific concern. Would you be receptive to legislation along those lines to drive these points home so that we really can have very, very honest, and insulated, and real scientific results? And so scientists out there are not concerned that their product is being influenced, compromised, and so we can have the right science to make our decisions.

Dr. DROEGEMEIER. Right. Yes, sir. I am always happy to work with Congress on any matter, and this one is extremely important, integrity across the board.

Mr. CASE. Thank you, sir.

Dr. DROEGEMEIER. Yes, sir. Thank you.

Mr. SERRANO. We will begin our second round. Now, Doctor, the administration has proposed a \$1.6 billion budget amendment that is just a down payment on the over \$20 billion in additional funding that would be required to launch the man moon mission four years early. Is it either technically possible, financially responsible, or necessary to launch the man moon mission four years early and an additional \$20 billion cost simply to meet a political deadline?

Dr. DROEGEMEIER. Thank you for that question. My understanding is that that \$1.6 billion is a down payment, as you say, on something that will be less than \$20 billion. I am a member of the National Space Council, which the vice president chairs.

I think going to the moon is a really critical step in the mission to Mars, which is the president's very high priority, I think as you know. I would leave it to Administrator Bridenstine to speak specifically to the issues you mentioned about budgets, and cost, and schedule, and things like that. But I think overall as a Nation, the president set the goal of going to the moon by 2024, landing on the moon, and then having a sustainable presence by 2028.

And so I think there are a lot of things that play into that, and a lot of things, especially, with the relationship to going to Mars.

Mr. SERRANO. Well, the director—the NASA director, of course, supports going to the moon. He understands the problems with finding the money. He also understands that this committee has been very generous to NASA and will continue to do so.

So my question to you is, by the way, you said it would cost less than \$20 billion?

Dr. DROEGEMEIER. I think—the numbers I have heard, the 1.6 billion is a down payment on something and it is over a five year period, I believe, that would be less than \$20 billion. That is the latest debt that I have heard.

Mr. SERRANO. You don't know how much less—

Dr. DROEGEMEIER. Sorry?

Mr. SERRANO. You don't know how much less?

Dr. DROEGEMEIER. I don't know how much less, but I heard it was less than \$20 billion, yes.

Mr. SERRANO. Now, what can we gain, other than to the ability to claim we were there first this time around?

Dr. DROEGEMEIER. Right. Right. Again, I think all the details of that, I think Jim Bridenstine could answer more than I could. I think it is more than sort of a political thing. I think there are—again, it ties into the mission of going to Mars. It ties in with the timelines of what private companies are doing, because the space launch system, of course, is a government system, but there are other things about getting crewed individuals to ISS. So it is a pretty complicated—sort of, complicated ecosystem, and I think Jim is much better suited to addressing that than I am. But what I told you is what my understanding of the situation, right.

Mr. SERRANO. This committee has a lot of faith in your abilities and your honesty. So I would hope that when the discussions come around, you let them know that we are serious in continuing to be helpful to NASA, and to space explorations, but that this is a big ask at a difficult time. And I think if you stay tuned to the news, you will see how difficult it is going to get in the next few days

around here about dollars and cents. A lot of dollars and a lot of cents.

Dr. DROEGEMEIER. Thank you for your support of NASA, sir. And I have great relationships with Mr. Bridenstine. He was in Congress from Oklahoma. We know each other quite well and worked together. And I feel like we can have, you know, good discussions and I can learn a lot by talking with him and also service on the space council.

Mr. SERRANO. Well, one of the things that I have repeatedly said to the committee, which they are tired of hearing already, but you haven't heard it yet, is that my experience, I have never seen an auditorium of children and young people, high school people, any age, as excited when an astronaut visits. And so there is excitement in the public, and there is support in the public—

Dr. DROEGEMEIER. Right.

Mr. SERRANO [continuing]. For man, space flights. It is just that we have to pay for a lot of other things, so—

Dr. DROEGEMEIER. Right.

Mr. SERRANO [continuing]. Just keep that in mind.

Dr. DROEGEMEIER. I tell you. I met with a middle school group of kids from Florida, and they are launching CubeSats. These are kids in middle school. They are building CubeSats. And they are real technology. It is not just a fun toy. I mean, it is really extraordinary. So it really underscores the point you just made about the excitement and the inspiration that that can provide to the next generation of stem learners. Yes.

Mr. SERRANO. Let me go just a little bit here over time and just ask you about the—last week, the press reported that the science division had no staff. Given the scientific challenges we face, this is troubling to say the least. How many positions are currently vacant at the agency?

Dr. DROEGEMEIER. You know, a lot people sent that to me. It was done in 2017. People didn't look at the date on the article. It was actually from 2017. So people that sent it to me, they said, "What is going on? OSTP is empty." I said, "Look on the date of the article. It is actually 2017."

So no, we actually have 80 people at OSTP. And if you take out the contractors and the interns, it is about—it is not about, it is 62 people. If you take out the administrative staff, I think it is about 49 and we have 26 MDs and Ph.D.s in that group. So it is really extraordinary. And the science staff is well staffed up.

Yes, so that article is actually two years out of date. I don't know, somebody released it and it got out there. But yes, it was written two years ago.

Mr. SERRANO. Okay. So in closing this round here, starting this round, at the Mueller hearing, they are waiting for a bombshell statement. We found out there is no presidential committee and now that you are fully staffed, so this is the news of the day.

Mr. Aderholt.

Dr. DROEGEMEIER. Thank you, sir.

Mr. ADERHOLT. I appreciate, Mr. Droegemeier, you mentioned the 50th anniversary of the landing. I had the privilege to be at that event on Saturday out at Cape Canaveral with the vice president, and to celebrate that 50 year mark. So it was great.

And of course, I am very encouraged about what NASA's mission is and what—our ability to go back to the moon in the very near future, and I think we can do that, and we are going to do everything we can to make sure that happens. And I appreciate the chairman's support for NASA funding and how we can continue to make that happen.

Let me follow up with one question on artificial intelligence that—in your opinion, and again just in closing before we go on to something else, do you think the U.S. has fallen behind in—with our competitors, like say China, that as we fund artificial intelligence research and other emerging technologies?

Dr. DROEGEMEIER. No. In fact, I think that we are really the world leader in AI. I think that is also true in quantum. I had the privilege of visiting Oxford University about two, three weeks ago. They have a massive quantum activity in that university, and they had spoken many times with the person at OSTP. His name is Dr. Jake Taylor, who runs our National Quantum Coordination Office. He spoke very highly of him and how wonderfully linked together we are in quantum.

So I think we lead those areas. I do think we have to be vigilant and continue to focus on those. And certainly, the president's high priorities. I think sometimes when you hear other countries, namely China, investing and they say we spend, you know, \$10 billion or whatever, that might be over a 10 year period of time, but there is no mention of that perhaps.

Also, it might be, as we talked earlier, what do you call AI? It might be there is something going on. There is a half a percent of AI and they maybe count the whole thing. So I am not saying they are being completely disingenuous, but I am just saying that one of the things we are trying to do is to really understand what the investments of other countries are vis a vis what we are doing. But regardless of that, we need to be really focused on the industries of the future because they are a huge part of our economy and the world structure going forward.

Mr. ADERHOLT. Okay. I think it is imperative that we win this race to deploy 5G technology.

Dr. DROEGEMEIER. Right.

Mr. ADERHOLT. Of course, NOAA and NASA claim that the FCC's out-of-band emission limits for the 24 gigahertz band will result in interference that could harm the collection of weather data via satellite by NOAA. Has the Administration reached a compromise regarding the allocation of federal spectrum for 5G use?

Dr. DROEGEMEIER. So there are really some robust discussions going on there. We have a long history in America of folks that have compelling needs and spectrum living next door to each other and being good neighbors. So I really feel that we will get there. I really do.

Mr. ADERHOLT. So you have—has a compromise been reached or—

Dr. DROEGEMEIER. There is still discussions going on.

Mr. ADERHOLT. So that has not been finalized?

Dr. DROEGEMEIER. It is still underway. It has not been finalized yet, no.

Mr. ADERHOLT. Do you believe it is possible to advance 5G use without compromising our Nation's interest in weather forecasting and other technologies that we would want to pursue?

Dr. DROEGEMEIER. I believe that we will get there. You know, technology is an amazing thing. It provides lots of methodologies to get to a good end point. And so I think this issue has been looked at very carefully, and so I believe we will get there.

One thing I would just add is when you look at our 5G deployment in America versus what some other countries are doing, there is different parts of the spectrum. And the reason that we are looking at all the different parts is certain parts have different characteristics. So if you look at the really high frequencies, you can push a ton of data over those things, but they are very short distance and they don't go through buildings. Okay, well, that is not great. So Okay, how do you deal with that?

Well, the very opposite end of the spectrum, low end, goes very long distances. It can go through buildings. But you can't push nearly as much data. So what we are doing in the U.S. is taking the low, mid, and high band spectrum and pushing all of those forward at the same time. Other countries aren't doing that. So we are being, I think, really progressive in how we are going to be deploying our 5G systems.

Mr. ADERHOLT. I mentioned in my opening statement that I was very interested in the perspective you bring to your office, given your extensive career in meteorology and extreme weather events. In southeast, which is of course where I am from, the State of Alabama in particular, we have experienced some of the most destructive, deadly, and intense tornadoes in the country. Matter of fact, I have heard a statistic that I think as far as any state dealing with deadly tornadoes, Alabama ranks number one, which surprises a lot of people, especially they think it is out maybe your way where those numbers would be.

But in March, for example, over two dozen people lost their lives when an EF-4 tornado tore through east Alabama. And that is why many of my constituents and others in the southeast value the federal research programs like NOAA's VORTEX Southeast, because it brings federal agencies together to help us better understand how environmental factors in the region affect tornado formation, the intensity, and their paths.

And despite the fact that the fiscal year 2020 budget request proposed, terminating important weather research programs, like the NOAA's Vortex Southeast, can you speak to the importance of these programs in furthering our understanding of the unique characteristics of tornadoes in the southeast, and how additional federal research, done in coordination with the universities, could be the key to saving lives and protecting property?

Dr. DROEGEMEIER. Yes. Thank you, sir. Well, first of all, I would say my thoughts and prayers go out to those folks who were affected by tornadoes, because being from Oklahoma, I see the devastation all too often, and it is really just extraordinary. Lives are torn apart, disrupted. But the hardy people of Alabama are rebuilding, just like the hardy people of Oklahoma. And so it is important that we do everything we can to understand the nature of these storms.

And frankly, the storms in the southeast are different, and that is why there was this program. For those of you maybe not familiar with it, the whole VORTEX program stood up about 1995, I believe it was. It stands for Verification of the Origin and Rotation and Tornadoes Experiment. The acronym winner above all.

And so it really is focused on exactly what it says. How do storms—how do these storms acquire rotation? In the southeast, compared to the midwest and Oklahoma, where we have these supercell storms, a lot of the tornadoes in the southeast come out of lines. They are kind of innocuous looking. Some of these F-4 tornadoes have come out of what we thought were fairly innocuous lines. Sometimes there is a heavy rain, you don't see the tornado, and all of a sudden you find this devastating tornado where you don't really have as much lead time as you do in Oklahoma, where these are much longer tracked storms.

So fundamentally, there are new things to be learned there. The VORTEX Southeast program, I think has been in place, the current one is a four year program that would—scheduled to end after the 2020 data collection period, I think next spring if I remember right. And so there is a lot of data that has already been collected. And this isn't the only campaign, I think, they have had in southeast.

I think the key thing is to gather as much data as we can, and analyze it, and really try to understand how these tornadoes are different in the southeast, which will probably help us in Oklahoma. And Oklahoma, understanding those tornadoes will also help us in the southeast. So it is really, really important. Folks die every year from these storms.

The other thing I would mention very quickly, though, is that we are also tackling this, the social behavioral science dimensions of this. Because at the end of the day, all the science and technology of the world won't keep people from dying. At the end of the day, if we are going to get to the goal of zero deaths, which is a goal I really feel strongly about, then we have to understand how people behave under certain threats of warning, and if they live in a mobile home park, what we need to do to protect them in ways different than if somebody has got a basement with a well built home.

So the totality of the problem, I think, is critical, but VORTEX Southeast is very important. These programs are very important.

Mr. ADERHOLT. By the way, I am proud that the subcommittee was able to work together under the chairman's leadership to restore the VORTEX Southeast funding in the 2020 House bill.

Mr. SERRANO. Couldn't have done it without you.

Mr. ADERHOLT. Okay. Glad I could help.

Mr. SERRANO. Mr. Cartwright.

Mr. CARTWRIGHT. Thank you, Mr. Chairman.

Dr. Droegemeier, I want to follow up on Mr. Aderholt's questioning about 5G. You know, we were going to have a hearing here with commerce secretary Wilbur Ross this year, but he skipped the hearing. So I didn't have a chance to question him about 5G development.

OSTP appears to be involved in 5G development, am I correct in that?

Dr. DROEGEMEIER. Yes.

Mr. CARTWRIGHT. In the research and in the deployment, right?

Dr. DROEGEMEIER. In the research and also looking at—well, working with USDA, for example, and the rural broadband initiative, and all those sorts of things, and what we actually need the R&D that is needed. Also, in terms of things like protecting our assets, right. That as well. So there are many different ways, correct. But it is one of the five industries of the future, right.

Mr. CARTWRIGHT. And you are working with the administration, the FCC, the Commerce Department on this important issue?

Dr. DROEGEMEIER. That is correct.

Mr. CARTWRIGHT. All right. Good. I am sure you agree that cybersecurity and data encryption are critically important issues with respect to the development of 5G in the U.S., right?

Dr. DROEGEMEIER. Yes.

Mr. CARTWRIGHT. And here is what I am after. Will you assure this committee that OSTP will either take a lead role on this issue, or at a minimum, make certain that the FCC and the Commerce Department understand our subcommittee's concerns.

Dr. DROEGEMEIER. About cybersecurity?

Mr. CARTWRIGHT. And 5G development.

Dr. DROEGEMEIER. Yes. Yes, indeed. Well 5G, of course, the president says we want to win the global race to 5G. So that is a marker in the ground. The other thing, cybersecurity, I mentioned in my confirmation hearing, I think is one of the gravest threats that we have to America and it is absolutely a top priority. So we will love to work with you and certainly all of the other agencies, yes.

Mr. CARTWRIGHT. Good. I will take that commitment, Doctor. I would also like to revisit a comment you made in your confirmation hearing. You said, "I believe science is extremely important in informing policy. I think science needs to be conducted free from political interference." Still feel the same way?

Dr. DROEGEMEIER. Absolutely.

Mr. CARTWRIGHT. All right. So a series of recently published reports highlights the USDA's decision, abruptly, to suspend its bee population study, which closely coincided with the EPA's decision to lift restrictions and broaden the use of the pesticide, Sulfoxaflo. The reports further highlight the fact that Dow Chemical, the parent company, the manufacturer of Sulfoxaflo, gave \$1 million to the Trump Administration for its 2017 inauguration.

Does this sound to you like science that is being conducted free from political interference?

Dr. DROEGEMEIER. Well, I would say the conduct of science in those studies is what I say needs to be free from political interference. I think how the science informs policy is another matter.

Mr. CARTWRIGHT. Now, the USDA recently scaled back and ultimately cancelled a science-based study on the impact of a proposed sulfite oar mine on the Minnesota boundary waters canoe area—wilderness area, despite commitments to Congress to finish the study. And on the heels of that decision, the DOI approved the renewal of mining leases to a subsidiary owned by a Chilean company, without understanding the full impacts.

Now, the owner of that company purchased the \$5.5 million mansion here in Washington, DC in late 2016 and rents that house to

Ivanka Trump and Jared Kushner. Does this sound like science that is conducted free from political interference?

Dr. DROEGEMEIER. Again, I am not familiar with that situation—

Mr. CARTWRIGHT. Fair enough. I will move on to the next one.

A recent political report indicates that the USDA's agricultural research service is refusing to publicize dozens of scientific reports on the effects of climate change. The report highlights research that documents the link between higher atmospheric CO₂ concentrations and the lowering of rice grain nutritional value, which could have a significant impact on populations who rely on rice as a significant portion of their diet. Rather than issuing a press statement to publicize these important findings, the USDA withheld their own press release and actively sought to prevent dissemination of the findings by the agency's research partners.

The University of Washington communications director said, "It was so unusual to have an agency basically say don't do a press release. We stand for spreading the word about the science we do, especially when it has a potential impact on millions and millions of people." That is what he said. Doctor, does that sound like science that is conducted free from political interference?

Dr. DROEGEMEIER. Again, I think the scientific research itself might have been conducted free from interference. What is actually done with that, I think, is another matter.

Mr. CARTWRIGHT. And finally, a Washington—

Dr. DROEGEMEIER. But I am not familiar—I read that, but I am not familiar with it, in the paper, yes.

Mr. CARTWRIGHT. A Washington Post article reported that the Department of the Interior ordered the National Academies of Sciences, Engineering, and Medicine to halt a study of health risks for residents near surface coal mining sites in the Appalachian mountains, citing a "changing budget situation." The Department's Inspector General, however, concluded that, "Departmental officials were unable to provide specific criteria," to explain why that study was cancelled.

Now, I am from northeastern Pennsylvania and my district faces years of mine reclamation and cleanup, and studies such as these are critical to providing the best information to make the most informed decisions now and for future generations. This appears to be another in a series of efforts by this administration to suppress scientific research that could reach conclusions that are contrary to its political efforts.

As a general principle, is it good science to cancel scientific studies, such as this one, without credible justifications? Do you agree that this example, at least, appears to be politically motivated?

Dr. DROEGEMEIER. I would have to learn more about that, to be honest, to really give you a thoughtful answer. I do—would tell you, though, that I think the president has funded more superfund site cleanups in this administration than the other previous administrations have.

Mr. CARTWRIGHT. Well, I will ask you to look into those questions that—

Dr. DROEGEMEIER. Sure.

Mr. CARTWRIGHT [continuing]. You were unable to answer.

Dr. DROEGEMEIER. I would be happy to.

Mr. CARTWRIGHT. And I appreciate your testimony, Doctor.

Dr. DROEGEMEIER. Sure, thank you.

Mr. CARTWRIGHT. Yield back.

Mr. SERRANO. Doctor, concerns have been expressed about the potential influence of foreign governments on scientists who receive federal funding. While we want to protect our investments in science, we also want to encourage collaboration and ensure that individuals aren't targeted due to their race or country of origin. Does OSTP plan to coordinate with federal grant making departments and agencies to develop consistent policy as to what constitutes foreign influence?

Dr. DROEGEMEIER. The answer is absolutely, yes. One of the four subcommittees of the Joint Committee on Research Environments is exactly that. We call it the Subcommittee on Research Security. It will address all of these issues and convene not only the inter-agency, but also the academic community, the private sector. We have already begun this, working with the national academies, with professional societies.

Now, let me just say that it is extremely important to recognize that science is an international endeavor, and we as a Nation have benefitted immensely from having scientists of—come in here from other countries and work with us. They win Nobel prizes, they start Fortune-100 and 500 companies. We also have to make sure that we appropriately balance the openness of our research environment, which also is extremely critical to our success and has been with the protection of our assets. So finding that balance is very, very important. And we don't want to stigmatize individuals who are coming from other countries.

In fact, the president in his plan for immigration mentioned he wants the best and brightest coming here, studying here, and staying here. So that is an unequivocal message, I think, that our doors are open with the important caveat that you come here legally, you come here through the front door, and also you adhere to the other part of our JCORE, and that is you act with integrity and uphold the values, which are fundamental to the research process itself.

Research itself, we just talked about, has to be conducted with integrity. So if you are coming here from another country, or even if you are here from the U.S., you are a citizen, and you are not acting with integrity, you don't belong in the research enterprise because you are fundamentally working against the entrusted situation that we have with taxpayers and how we actually need to conduct research to know that it is free from undue influence of any other kind, other than just trying to discover how nature works.

So we are on top of that very strongly, sir. And I am happy to say that because there is a lot of good work happening, but we have to make sure that we have harmonization and agreement, and everybody sort of works together on this important problem.

Mr. SERRANO. This is not directed at you, because you are only quoting the president, but I can't help myself. I don't think I ever saw on the Statue of Liberty, "Give me your best and your brightest," I saw, you give me, "Give me your poor and your tired," and it goes to the hurting and yearning. But anyway, will universities

and other research institutions be required to monitor their employees with respect to any inappropriate foreign ties that they might have?

Dr. DROEGEMEIER. Of course, our work is still ongoing, but I can tell you that some universities are already taking measures to do that.

Mr. SERRANO. Yeah.

Dr. DROEGEMEIER. And what we have to make sure, now back to another subcommittee of JCORE's to make sure that we don't create additional burdens and additional processes that aren't going to be effective. So that is why we brought in the intelligence community, the law enforcement community, FBI. We have brought in the National Security Agency. They are all involved with this new Subcommittee on Research Security.

So we have got all the right folks at the table, including the academic enterprise. Now, universities are obviously free to do whatever they want to do. But we think that if we come up with a series of best practices—not we. When I say we, I mean the community with OSTP convening. But that is probably the best way to get to a solution. Yes.

Mr. SERRANO. Thank you. Mr. Aderholt.

Mr. ADERHOLT. The FCC has approved the operation of very large constellations of commercial satellites in low earth orbit, and plans to approve more, of my understanding. This activity involves important policy issues involving orbital assignments, orbital debris mitigation, frequency interference, spectrum allocation, and degradation of astronomical observation, among other things.

What is OSTP's role in regard to these matters?

Dr. DROEGEMEIER. That is a really great question, and so number one, first and foremost, we have a seat on the National Space Council. And so I am privileged to have that seat, that of course is chaired by the vice president. We also have a lot of work going on in the area of things like space debris, space traffic management, through some of the orders that were issued as part of the so-called space policy directives that were issued when the space council was stood up.

So we have issued reports on those sorts of things and it is very critical that we work with, and are working with, all of the groups that have equities in that, including the FCC, the commerce department, the military, and so on.

Our low earth orbit space assets are really, really critical. And in my confirmation hearing, we talked a lot about the ISS, the International Space Station, how we want to not cede low earth orbit to other countries. So this is really important that the commercial enterprise be able to operate in low earth orbit, with safety, with the ability to track the management, and also things like space weather. The space weather plan that we put out looks at what the impacts of coronal mass ejections from the sun would do in terms of some of these assets, as well as electromagnetic pulses from high altitude nuclear explosions.

So we are very heavily involved in all of those things.

Mr. ADERHOLT. Do you—so based on that, do you believe that OSTP has a responsibility to protect the scientific assets of the

U.S., as we mentioned the space station and scientific satellites in orbit from low earth orbit space junk?

Dr. DROEGEMEIER. So not necessarily protecting, but being involved in the conversation about the science and technology that is needed to do that and some of the policies that are in place. So the actual protection part could be, you know, the Commerce Department, for example, and regulating launches, and the FAA, and the FCC, and also the military. So we are one of several folks at the table.

Mr. ADERHOLT. Is OSTP actively protecting these assets and licensing discussions?

Dr. DROEGEMEIER. In terms of spectrum licenses or launch licenses?

Mr. ADERHOLT. Yes, launch.

Dr. DROEGEMEIER. Launch licenses? I don't think—I would have to maybe get back to you on this. I don't believe we are involved too much. Although one thing we did do in the National Space Council is look at streamlining the mechanisms by which one actually obtains a license. So you can—if you get, I think, one license, you can launch a whole bunch of vehicles, you know, with that one license rather than going back every time.

So we are trying to reduce the regulatory burden to empower space commerce. So that is one example. But the actual licensure itself, I think we are not involved in that directly, except for the policy of streamlining it.

Mr. ADERHOLT. Thank you, Mr. Chairman.

Dr. DROEGEMEIER. Thank you, sir.

Mr. SERRANO. Thank you for coming before us and your answers to our questions. We hope to see you again and keep working on these issues. This is a very important area, one that we take seriously, this committee, and we will continue to do that kind of work in a bipartisan fashion, and I mean that sincerely.

Dr. DROEGEMEIER. Thank you, sir, very much for your good work and I really look forward to working with you. Very good questions, very good engagement. Thank you for the great work you do.

Mr. SERRANO. Thank you.

Dr. DROEGEMEIER. Thank you, sir.

Mr. SERRANO. Committee is adjourned.

[Answers to submitted questions follow.]

The Honorable Robert Aderholt
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record

CHINESE TALENT PROGRAMS

Many foreign researchers are in the U.S. working and making great contributions at our universities and other institutions. Yet, foreign talent-recruitment programs are a known threat to the U.S.'s technological superiority. These programs are efforts by our foreign competitors, particularly the Chinese, to leverage their scientists in the U.S. in order to facilitate the illicit transfer of U.S. technology and intellectual property to China and elsewhere.

1) What is OSTP doing to address the exploitation of U.S. research by other nations?

Answer. The open and collaborative nature of the United States research enterprise underpins America's innovation, science and technology leadership, economic competitiveness, and national security. We recognize and value the tremendous contributions that scientists – both U.S. citizens and foreign nationals- make to the American research enterprise. Unfortunately, some countries do not demonstrate a reciprocal dedication to open and collaborative environments and seek to exploit open U.S. and international research environments to circumvent the costs and risks of conducting discovery research, thereby increasing their economic and military competitiveness at the expense of the United States and its allies.

Foreign talent recruitment programs are one manner through which foreign governments seek to exploit the research enterprise. These programs are efforts directly or indirectly organized, managed, or funded by a foreign government, including state-owned enterprises, or foreign institutions, to recruit science and technology professionals or students (regardless of citizenship or national origin, and whether having a full-time or part-time position) with the intent to import or otherwise acquire from abroad proprietary technology or software, unpublished data and methods, and intellectual property to further the military modernization goals and/or economic goals of a foreign government. Many, but not all, programs aim to incentivize the targeted individual to physically relocate to the foreign state for the above purpose. Some programs allow for or encourage continued employment at U.S. research facilities. Compensation could take many forms, including cash, research funding, honorific titles, career advancement opportunities, promised future compensation, or other types of remuneration or consideration, including in-kind compensation.

On May 6 of this year, OSTP, through the National Science and Technology Council, formally established the Joint Committee on the Research Environment (JCORE). The Committee brings together the leadership of two standing Committees under the Council: The Committee on Science and the Committee on the Science and Technology Enterprise. This top-priority Joint Committee contains four subcommittees: research security, safe and inclusive research environments, research rigor and integrity, and coordinating administrative requirements for research.

The Research Security Subcommittee convenes 19 Federal science, foreign affairs, and security agencies and has met eight times since May. The Subcommittee is pursuing four lines of effort:

- Coordinating outreach and engagement with Federal agencies, academic research institutions, companies, non-governmental organizations, researchers, and students. In order to help relay the nature and scope of the challenges America faces, JCORE is assembling an array of examples in which our research enterprise was exploited or compromised.
- Establishing and coordinating disclosure requirements for participation in the federally-funded research enterprise. Disclosure is a central tenet of research integrity and a key mechanism for ensuring compliance with applicable policies and laws

- Developing best practices for academic research institutions, in collaboration with academia, professional societies, and other organizations.
- Developing methods for identification, assessment, and management of risk in the research enterprise.

Recognizing the strong interest by Congress in research security and other lines of effort within JCORE, OSTP is communicating JCORE's activities to Congress. Expected outcomes from JCORE include a mixture of best practices for research performers, refinements to existing and possibly additional policy, continued assessments of threats and vulnerabilities, and ongoing discussions to ensure effective communication and understanding among all stakeholders.

- 2) How can our institutions better protect U.S. technology and I.P. assets without casting suspicion on all Chinese and other foreign scientists in the U.S.?

Answer. JCORE's Research Security Subcommittee is pursuing a specific line of effort on developing best practices for academic research institutions, in collaboration with academia, professional societies, and other organizations. The focus is not solely on foreign scientists in the United States. Rather, the focus is on establishing and upholding the principles and practices of research integrity for all participants in the American research enterprise, regardless of nationality or country of origin.

ADVANCED MANUFACTURING

Manufacturing is a key industry in my district in Alabama, and I am supportive of the Administration's efforts to set forth advanced manufacturing goals that will prepare our workforce for the future, help integrate new, innovative technologies into the industry, and maintain American competitiveness.

- 3) Can you explain how OSTP's October 2018 "Strategy for American Leadership in Advanced Manufacturing" will help the manufacturing industry grow and progress, and prepare our workforce for the future?

Answer. Preparation of the workforce, as recognized in the advanced manufacturing strategy report, is clearly essential for the growth and progress of the manufacturing sector of the U.S. economy. The STEM initiatives identified in the report link directly with those in the report from the National Science & Technology Council Committee on STEM Education - *Charting a Course for Success: America's Strategy for STEM Education*. The STEM report underlines the Administration's recognition of the importance of workforce preparation and directs executive branch agencies to work together with state, local, and private sector partners to deliver on the priorities it identifies. The report identifies the pathways needed to achieve the overall vision for a future where all Americans have lifelong access to high quality STEM education, which will ensure continued U.S. leadership in innovation and R&D – the essential precursor of a strong manufacturing sector and the employment opportunities that accompany it.

- 4) Also, how will this strategy prepare American manufacturers to be more competitive with foreign entities?

Answer. The report identifies several important components that underlie American advanced manufacturing competitiveness. These include public investment, and public-private partnerships in basic and early stage applied research to reverse the trend of decreasing investment in manufacturing capacity in the U.S. The institutes of the Manufacturing USA network are prime examples of this initiative. Other important components emphasize the role of the Federal Government in "leveling the playing field," including the protection of intellectual property rights, and identifying unfair and illegal

trade practices which put U.S. manufacturing firms at a disadvantage. The Administration has taken clear and decisive positions on these issues to promote American manufacturing competitiveness.

QUANTUM COMPUTING

In December of last year, President Trump signed the *National Quantum Initiative Act* into law. Since then, under your direction, OSTP has chartered the National Quantum Coordination Office and established the Subcommittee on Quantum Information Science under the National Science and Technology Council.

- 5) Beyond establishing the Office and Subcommittee, how is OSTP implementing the *National Quantum Initiative Act* and how will the request support these efforts in fiscal year 2020?

Answer. The National Quantum Initiative Act (NQIA) requires substantive actions across the executive branch to ensure our Nation’s continued leadership in quantum information science. We take this challenge very seriously and have been deeply engaged in a timely roll-out of the authorized activities. As you mentioned, we have already formed the National Quantum Coordination Office (NQCO) and appointed Dr. Jake Taylor as Interim Director of the Office. Subsequently, we have taken several additional key steps. Let us examine this question in two parts: implementation and budget.

Regarding implementation of the NQIA, we now have several staff working in the NQCO, covering the six key policy areas identified in the “National Strategic Overview for Quantum Information Science” that OSTP published last year. These policy areas – science, workforce, industrial engagement, infrastructure, economic growth and national security, and international cooperation – support the main tenets of the NQIA.

In May, we re-chartered the National Science and Technology Council’s (NSTC) Subcommittee on Quantum Information Science (SCQIS) at the “White House Academic Roundtable on Innovation in Quantum Science” to ensure that the SCQIS’s functions and duties are consistent with the NQIA. We also re-aligned agency participation to ensure that all agencies with equities in QIS would be represented. The SCQIS continues to meet regularly. Furthermore, under the SCQIS, we have begun a deep engagement across the agencies to prepare the strategic plan, called for in the Act, for review by the National Quantum Initiative Advisory Committee (NQIAC). At the same time, we worked with the National Science Foundation to re-open a Request for Information to enable external stakeholder inputs into the strategic plan, which closed in August.

We have also created working groups for Science, Workforce, Industry, and Infrastructure, and a task force to engage on International Cooperation. As the Committee may be aware, we have a second NSTC Subcommittee on Economic and Security Implications of Quantum Science (ESIX) to enable discussions regarding economic growth and national security at an appropriate level, and ESIX works closely with the SCQIS and the NQCO to ensure our planning process supports the overall National effort efficiently and effectively.

Most recently, President Trump signed executive order 13885 establishing the National Quantum Initiative Advisory Committee (NQIAC) and delegating aspects of its operation to the Department of Energy. This was followed quickly by a Request for Information from the DOE calling for nominations, which the White House and OSTP distributed widely to stakeholders around the Nation.

Regarding the President’s budget request for FY 2020, the request provides \$430 million for basic quantum information science (QIS) research and development. This includes \$168 million in the Office of Science at the Department of Energy, more than \$105 million at the National Science Foundation’s QIS programs, and more than \$40 million for the National Institute of Standards and Technology. These requests represent a path towards full implementation of the activities under the NQIA, reflecting the necessary “building-up” process that any scientific program will encounter.

- 6) How will the National Quantum Coordination Office and the Subcommittee on Quantum Information Science work to advance the United States' position in fundamental quantum research?

Answer. The NSTC Subcommittee on Quantum Information Science (SCQIS) supported by the National Quantum Coordination Office (NQCO) will provide the long-term planning and knowledge retention to ensure well-coordinated programs are implemented across the agencies. The structure of working groups, combined with appropriate internal and external gatherings, are intended to support the overall national strategy for QIS that is presently under development.

For example, the SCQIS worked with the NQCO to host the first "QIS Program Day," bringing in more than 60 people representing more than a dozen agencies from across the Government, to brief their entire quantum portfolios and engage in detailed discussions about next steps. This program day looks to become an annual gathering to ensure good planning and to improve our ability to report to Congress as required under the NQIA, as well as following best practices for coordination as outlined by the Government Accountability Office. We are also developing several internal resources for government program managers and decision makers to ensure broad knowledge and connections between programs are easy to find and leverage.

As another example, OSTP and the NQCO have worked with NIST, the Department of Commerce, and the Air Force Research Laboratory to obtain the legal and fiscal agreements required to enable the creation of the Quantum Economic Development Consortium called for in the NQIA, with the first round agreements signed earlier this month (September). The SCQIS's role was to realize that the consortium can benefit more than just the NQI implementing agencies, and to encourage taking a cross-cutting approach so that the defense and intelligence communities, and other civilian agencies, could also benefit from the consortium activities.

JOINT COMMITTEE ON RESEARCH ENVIRONMENTS ("J-CORE")

In May, the National Science and Technology Council launched the Joint Committee on Research Environments. The Council, known commonly as "J-CORE," is intended to address the most pressing challenges facing America's research and scientific community.

- 7) Can you explain what prompted the Administration to establish JCORE?

Answer. JCORE was established to address areas that are particularly salient to the research environment at this time, each addressed through individual interagency subcommittees consisting of Federal science funding agencies, offices and security agencies, and coordinated by the Office of Science and Technology Policy. These include:

- **Safe and Inclusive Research Environments** – This Subcommittee aims to address issues of physical security (e.g., laboratory safety) as well as all forms of harassment – to ensure that everyone, including students, postdocs, faculty and others, can fully engage in research, debate openly and with civility, and be respected regardless of sex, race or other factors. A successful STEM workforce requires the participation and active engagement of all segments of the population.
- **Research Rigor and Integrity** – The focus of this Subcommittee is on identifying agency and stakeholder principles and practices that will further enhance research quality. This includes measures that facilitate good experimental and statistical design, data sharing and transparency in reporting to facilitate reproducibility and replicability, validation of key resources such as cells and reagents, and other means.
- **Research Security** – JCORE's Research Security Subcommittee engages Federal science funding and security agencies to identify and coordinate policies and practices that strengthen the security of America's research enterprise without compromising our values or our ability

to maintain the open and internationally vibrant innovation ecosystem that has underpinned our leadership in science and technology. The subcommittee and its agency members engage with the academic community to raise awareness of potential threats and of mechanisms to address them.

- Coordinating Administrative Requirements for Research – Numerous surveys and reports have indicated that federally funded researchers spend a significant portion of their time on federally funded projects completing associated administrative and compliance requirements. This subcommittee seeks to reduce unnecessary administrative work by streamlining, coordinating, harmonizing, and modifying existing federal regulations, policies and processes while maintaining necessary protections.

OSTP serves to convene and coordinate these Federal agency efforts.

- 8) How will JCORE ensure that America’s research environments uphold the highest standards of integrity and reflect American values?

Answer. The JCORE subcommittees will provide the guidance and resources needed to strengthen the quality and integrity of the U.S. research enterprise and to promote transparency. The subcommittees have met a number of times to develop priorities, guidance and communications and are making good progress in these efforts. As noted in the response to question 7, one subcommittee is focused specifically on research integrity. Research demands that those entrusted with funds, be they of public or private origin, operate with the highest standards of integrity and ethics, consonant with American values. This is what I, as OSTP Director, have been stating publicly for the past several months, including in my September 16, 2019 letter to the U.S. research community.

- 9) Are America’s research environments experiencing persistent issues with ethics, safety, and integrity standards?

Answer. Researchers are passionate about the work that they do –work that contributes to our Nation’s health, economy and security. The vast majority of researchers adhere to the norms of our society and the policies of their institution and the Federal government. Federal standards, policies, training and other resources help to ensure that research is conducted in a safe and ethical manner and with the highest integrity. The minority of individuals who violate these policies are subject to loss of funding and employment.

LOW EARTH ORBIT (LEO) “SPACE JUNK”

The FCC has approved the operation of very large constellations of commercial satellites in low earth orbit and plans to approve more. This activity involves important policy issues involving orbital assignments, orbital debris mitigation, frequency interference, spectrum allocation, and degradation of astronomical observation, among other things.

- 10) What is OSTP’s role with regard to those matters?

Answer. OSTP does not play a role in the approval of the operation of commercial satellites.

- 11) Do you believe that OSTP has a responsibility to protect scientific assets of the United States, such as the International Space Station and scientific satellites in orbit, from LEO space junk?

Answer. OSTP provides the President with advice on the scientific, engineering, and technological

aspects of the economy, national security, homeland security, health, foreign relations, the environment, and the technological recovery and use of resources, among other topics. OSTP does not play a role in the approval of the operation of the International Space Station or commercial satellites.

- 12) Is OSTP actively protecting these assets in the licensing discussions?

Answer. OSTP does not play a role in the licensing of commercial satellite operations.

- 13) Does OSTP consider clear skies a national asset? Are you concerned about how global astronomy might suffer as a result of thousands of bright objects obscuring our view of the heavens?

Answer. OSTP does not play a role in the approval of the operation of commercial satellites.

NASA MISSIONS AND THE ROLE OF OSTP

Science remains a very important NASA mission. Increased understanding of our solar system and the greater universe is important to help us understand our own earth.

- 14) What role does your office play in shaping and implementing the White House’s plan for space other than attending Space Council meetings?

Answer. Through the National Science and Technology Council (NSTC), OSTP co-chairs subcommittees and working groups related to space. For example, under the Committee on Homeland & National Security is the Subcommittee on Space Weather, Security, and Hazards (SWSH). The SWSH Subcommittee and its working group coordinate Federal department and agency activities across a range of space-related areas including enhancing our understanding of and resilience to space weather; improving capabilities for prediction of and National preparedness for hazards posed by near-Earth objects; and ensuring the ability to use space nuclear systems safely and sustainably.

Additionally, OSTP plays a major role in shaping and implementing the Administration’s plan for space through the release of the annual Administration Research and Development Budget Priorities memorandum, which OSTP develops in coordination with the Office of Management and Budget. The Fiscal Year 2021 memorandum, released on August 30, 2019, includes American space exploration and commercialization as one of the five R&D budgetary priorities for the Administration.

The Office of Management and Budget (OMB) reviews and helps structure the President’s annual budget request.

- 15) Is the role of OMB to continue to “manage” the space program throughout the year and to control the release of funds at levels below the topline budget? If so, what is the role of the NASA Administrator?

Answer. I defer to OMB to describe the role of that office.

- 16) Do you support NASA science missions like the Europa mission to Jupiter’s icy moon?

Answer. Yes, I support exploration of the solar system, and continuation of the tremendous science missions that NASA plans and conducts.

- 17) Is your office aware that the Exploration Upper Stage version of the Space Launch System provides three to four times even the most optimistic capability for payload insertion beyond Low Earth Orbit of so-called commercial rockets?

Answer. My office has been briefed on the Space Launch System, and I recently visited the Kennedy Space Center to learn more about it and the Artemis program.

- 18) Can you describe to what extent your office been briefed on the unlikelihood that commercial rockets will be flying missions beyond low earth orbit by 2022 and that we will have to pay reusable rocket prices to get any trans lunar injection capability of 10 metric tons or greater?

Answer. My office is briefed on various issues and scenarios. At OSTP, we routinely hear from a variety of stakeholders and government partners and I welcome the opportunity to hear more.

The Administration is unable to provide Congress a budget for the Moon mission. I am concerned that part of this is a reluctance to pay for items that are capable and safe, along with a wish that the private sector would do this instead of the government.

- 19) Is a mission to Mars and a human presence on the Moon important to our national security? Please explain whether the program managers and private partners for the SLS system have briefed you on the risk reduction and cost per pound to launch missions on the SLS compared to numerous commercial vehicle and whether the SLS could reduce costs and risks if it were not being blocked in some of our space planning (payloads and missions being compelled to fit on smaller, commercial rockets).

Answer. Yes, ensuring American leadership in space, both through missions to Mars and a sustainable human presence on the Moon, is important to our national security. I personally have not been briefed directly by program managers and private partners regarding the SLS topics you listed, but I welcome the opportunity to hear from them and any other stakeholders.

SCIENTIFIC METHOD

The Scientific Method includes making observations, developing hypotheses to explain the observations, making predictions based on the hypotheses, testing the predictions with reproducible experiments, evaluating the results of the experiments, and making new hypotheses or predictions based on the results of the analyses.

- 20) As a scientist, can you tell if the words “settled science” have any legitimate or helpful role in the scientific method of observation and hypothesis testing?

Answer. As you stated in your question, the scientific method is a continuous process of observation, hypothesis generation, testing, and evaluation. This leads to constant refinement and, in many cases throughout history, to complete paradigm shifts. The idea that something is “settled” implies that a given scientific question has been answered completely, the answer is inviolate, and nothing new can be learned. In general, I disagree with this notion, especially when dealing with complex systems. The scientific community should not stop questioning, testing, evaluating and ultimately improving our understanding of the natural world.

- 21) Can you help this Committee understand whether there is an appropriate role for “consensus” in the scientific method, and if so, can you describe how the scientific method can most rigorously draw valid scientific conclusions by consensus?

Answer. Consensus is not part of the scientific method. A good scientist follows the evidence, wherever it may lead. For some scientific problems, there exists a large body of evidence, often generated by many researchers approaching the problem in many different ways over decades. Over time, a “consensus” might build among researchers around the answer to a given question. Because so many fields of science intersect, and scientific progress today builds on the results of the past, understanding where the evidence is strongest is critical. Consensus long existed regarding the structure of the atom, for example, only to be overturned when large particle accelerators provided insight into sub-atomic particles as suggested by theory. Yet many questions remain.

That said, consensus does not mean that all scientists agree on every aspect of the answer or that the process of testing, evaluation, and refinement should cease. There are well known cases in history (e.g., stomach ulcers and *Helicobacter pylori*) where the scientific consensus was wrong.

- 22) If you, as a scientist, disagreed with the scientific conclusions drawn by another scientist’s research, what would be the appropriate scientific action for you to take?

Answer. The most appropriate action would be for me to conduct a study or series of studies of my own, rigorously applying the scientific method, that seek to refute someone’s research outcomes with which I have disagreement. My results then would be subject to appropriate merit review, and possibly reproduction or replication by others, to determine their veracity. This is a very healthy and normal course of scientific research.

- 23) If you were to make a personal attack on another scientist because you disagreed with their conclusions drawn from an experiment, would you call that ethical behavior?

Answer. Personal attacks have no place in the research enterprise because research depends upon trust, collegiality, and mutual respect. Constructive critiques and the free exchange of ideas have a prominent place in science; personal attacks do not.

- 24) Is it possible that a scientist would interpret personal attacks that they experience over scientific disagreements as a message from the science community that their participation in the conduct of science is not welcomed?

Answer. While one scientist or a group of scientists do not represent the “scientific community,” personal attacks have no place in science, as noted in my answer to the previous question. I believe strongly that the research environment should serve as a safe venue for the free and respectful exchange of ideas, including constructive critiques of research results. The research environment must be welcoming of all people. This is why I created the NSTC Joint Committee on the Research Environment (JCORE) in May of this year. Two JCORE subcommittees are very relevant to your questions: The Subcommittee on Safe, Inclusive Research Environments and the Subcommittee on Research Integrity. I would be pleased to discuss these or the other JCORE subcommittees with you or members of your staff at your convenience.

- 25) Is it possible that personal attacks on scientists can result in the consequence of excluding individuals from engaging in scientific research and can limit the diversity of participation and thought in a scientific field?

Answer. Absolutely. Research shows that feelings of exclusion can negatively impact participation in science, especially for women and traditionally underrepresented minority groups. This is true for all manner of personal attacks, harassment, and unwelcome behavior.

- 26) Would you characterize a record of intentional, personal attacks by one scientist on another scientist over scientific disagreements as a compromise of scientific integrity?

Answer. A 2017 National Academies report¹ identified six values that underpin scientific integrity—objectivity, honesty, openness, accountability, fairness, stewardship. The report also discusses norms and best practices for research integrity. Repeated personal attacks can erode these values and norms (e.g., collegiality). To the extent such attacks lack honesty, objectivity, or lead to unfair or biased actions (e.g., reviewing a research proposal unfairly), then yes, this could compromise scientific integrity.

PEER REVIEW PROCESS – BETTER UTILIZATION OF THE EXPERTISE AT U.S. RESEARCH UNIVERSITIES

It has been said that the peer review process used by U.S. federal agencies for awarding competitive grants to university scientists to do fundamental research may not be perfect, but there's no better process in the world. I would hope that we could all agree that fundamental inquiry-based research – such as that sponsored by the NSF, NIH, DOE's Office of Science, NASA's Science Mission Directorate, NOAA's Office of Oceanic and Atmospheric Research, and the DOD's fundamental research agencies and laboratories – thrives when peer-reviewed competition brings out the best and most innovative ideas from the broadest possible community of university scientists and engineers located across the entire nation.

But I'm wondering if the science and technology needs of mission-oriented federal Departments and Agencies such as NASA, NOAA, the Department of Defense, the Department of Homeland Security, and others, are able to maximally benefit from the science and technology expertise and capabilities residing at our nation's research universities if our federal agencies can only get access to these capabilities through a full and open federal acquisition process.

Starting and managing full and open federal acquisitions can be a lot of work for already-busy federal employees, can be costly for the federal agency, can result in extended legal protests, may not pass a cost-benefit analysis, and can simply take too long when compared to the timescale of the need for a solution.

To use an example that you would surely be familiar with, I'm not sure that it would make much common sense for the National Severe Storms Laboratory in Norman, Oklahoma, to hold a full and open competition every time that it wanted to draw upon the vast meteorological expertise of the faculty, staff, and students at the nearby University of Oklahoma.

My understanding is that federal regulations currently do allow for timely and cost-effective access to the expertise and innovation residing in academia.

Specifically, 48 C.F.R. Section 6.302-3(a)(2)(ii) states:

Full and open competition need not be provided for when it is necessary to award

¹ National Academies of Sciences, Engineering, and Medicine. 2017. *Fostering Integrity in Research*. Washington, DC. The National Academies Press. doi: <https://doi.org/10.17226/21896>.

the contract to a particular source or sources in order ...to establish or maintain an essential engineering, research, or development capability to be provided by an educational or other nonprofit institution or a federally funded research and development center ...

C.F.R. 48 Section 6.302-3(b)(2) also states:

Use of the authority in paragraph (a)(2)(ii) of this section may be appropriate when it is necessary to – (i) Establish or maintain an essential capability for theoretical analyses, exploratory studies, or experiments in any field of science or technology; (ii) Establish or maintain an essential capability for engineering or developmental work calling for the practical application of investigative findings and theories of a scientific or technical nature; or (iii) Contract for supplies or services as are necessary incident to paragraphs (b)(2)(i) or (ii) of this section.

- 27) Can you address for this Committee if you think that the federal government’s mission-oriented department and agencies can better utilize the science and technology expertise residing in our nation’s research universities?

Answer. The Federal government and research institutions both benefit from exploring additional mechanisms for engagement to answer research questions and to translate research into new innovations and products. OSTP fully supports and plans to further explore the multifaceted ways in which government, universities and industry can partner to further their missions and benefit American taxpayers.

- 28) And, do you think that additional guidance and training for federal program managers and acquisition personnel regarding the appropriate use of the regulations above to engage with research universities might help government departments and agencies better perform their missions for the taxpayers?

Answer. Ensuring that federal managers and acquisition personnel are aware of and empowered to use all legal means for engaging with research universities can only serve to benefit both parties. Acquisition professionals, including contracting officers and program managers, receive extensive and continuous training through the Federal Acquisition Institute, which has been charged with fostering and promoting the development of a federal acquisition workforce under title 41 of the U.S. Code. The regulations noted above are thoroughly covered in this training.

EXAMINATION OF CLIMATE MODELS

Many studies have demonstrated that even the latest climate models apparently show too much sensitivity to greenhouse gases. For example, the bulk atmospheric temperature, which is a major response variable to GHG, in the last 40 years has warmed much less than models have indicated it should. Indeed, things are not improving as the most recent US CESM2 model has estimated a climate sensitivity of about 3 times what is estimated from actual observations (Gettelman et al. 2019 value of 5.3K vs. observational estimates of < 2 Lewis and Curry 2017). These are published, scientific results.

- 29) What are you doing to objectively and independently report on and evaluate such deficiencies since very consequential and costly policy, as you indicated at the hearing, is

largely dependent on these questionable model results?

Answer. The most effective way to address disagreements regarding any research topic, or any given study, is via additional research that rigorously follows the scientific method, with research outcomes subjected to merit review by subject matter experts having no conflicts of interest. It not only is *not* unusual for research studies to disagree with one another, but indeed, it is an inherent and valued characteristic of studying the natural world. As noted in a brand new National Academies of Science, Engineering and Medicine study² on reproducibility and replicability in science, “A goal of science is to understand the overall effect from a set of scientific studies, not to strictly determine whether any one study has replicated any other.”

- 30) Given that the budgets for weather and climate model development are together relatively fixed, which would the American people and American commerce find of greatest benefit - an improvement in the two to three week forecast, or in more exercises of questionable forecasting of what might happen the next 100 years?

Answer. To address this question, it is important to delve somewhat into details – because terminology and application of computational models to the time scales given in the question are different.

Consider first the 100-year timescale. Climate, or Earth system, computer models do not “forecast” the future in the way we think of conventional weather forecasts seen on TV, which also are produced by computer models. Conventional computer weather forecasts are based upon collecting a vast array of observations to determine what is happening right now (the initial condition). Then, using this initial condition as the starting point, the models solve complex equations representing key atmospheric characteristics (wind, pressure, temperature, precipitation) to determine how those characteristics change over hours to several days. Such models do not include changes in anthropogenic forcing from fossil fuels or other factors because, on time scales of a few days to a couple of weeks (that is, a conventional weather forecast), such effects are negligible.

When these same sorts of models are applied to timescales of a century, anthropogenic effects are in fact important, along with natural variability. Models run over these vastly longer time periods do not start from a set of observed initial conditions, but rather from a statistically steady state achieved when anthropogenic forcing is held constant and the model comes to an equilibrium and does not change statistically with time. Then, the anthropogenic forcing is turned on, with the model responding accordingly. Because we do not know with certainty how the anthropogenic forcing will change over the next 80 or more years, various estimates are made which include possible evolutions in the energy mix, technology, population, land use, etc. For all of these reasons, such model simulations are called *projections*, not forecasts.

In order to make the projections of 80 to 100 years described above, the model physics and spatial resolution (the distance between points at which atmospheric quantities are computed) must be simplified and lowered, respectively, owing to limitations in today’s computer resources. Consequently, the models are operated *far below* their actual capability, leading to uncertainty not only from anthropogenic forcing, but also from insufficient representation of important phenomena such as clouds, precipitation, and land-atmospheric exchanges of various gases.

The first point here is that, although value exists in long-term climate projections, say to 100 years,

² National Academies of Sciences, Engineering, and Medicine (2010). *Reproducibility and Replicability in Science*. Washington, DC: The National Academies Press. <https://doi.org/10.17226.25303>.

our current projections suffer from known limitations and thus must be interpreted with great care. The second point is that we are able to do much better today, in how models represent atmospheric processes, than existing computer capabilities allow in practice. I would very much welcome a discussion with you along these lines.

Turning now to the other part of your question, namely, a timescale of two to three weeks, this is the scale for which existing and highly capable weather forecast models operate. The theoretical limit for such forecasts is approximately two weeks, and it is generally recognized that the period from three weeks to a few months – so-called seasonal to sub-seasonal (S2S) forecasting – represents an area of tremendous potential societal benefit. Why? Because important decisions in agriculture, construction, transportation, and other areas involving financial and other forms of risk reside in this time period. Indeed, the Weather Research and Forecasting Innovation Act, signed into law by President Trump in 2017, explicitly lists S2S as a significant priority. In response, the National Oceanic and Atmospheric Administration (NOAA) is actively pursuing this topic, as are academic research institutions. S2S represents the “weather-climate interface,” and as a result, both weather and climate/Earth system models will benefit from advances made in this forecast time horizon.

In summary, the answer to your question is that value resides in forecasts of a few weeks to a few months, but also in much longer-term Earth system projections. Investments in one will benefit the other.

- 3) Would you welcome an independent and objective analysis of the National Climate Assessments if you were shown specific and solid evidence of misleading and erroneous information contained in these reports?

Answer. It is very important that any document, including National Climate Assessments, be as accurate as possible and adhere to extant guidelines governing assessment reports. I would note that the Fourth National Climate Assessment (NCA4), released in late November 2018, underwent multiple cycles of review including two significant external reviews. The first external review was by the National Academies of Science, Engineering and Medicine, and the second was via a Federal Register Notice, to which anyone in the world was able to respond. I would further note that NCA4 is a compilation of existing research and other documents, the preponderance of which underwent expert peer review. Finally, it is always important to pursue additional research that rigorously follows the scientific method.

The Honorable Charlie Crist
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
White House Office of Science and Technology Policy

1. Given the scientific evidence of climate change, how will OSTP be using that science to help prepare our country for climate change and to guide the creation of policies that protect lives and livelihoods?

Answer. OSTP provides scientific guidance to the President on a wide array of policies, including global change. Within the National Science and Technology Council (NSTC), which the OSTP Director chairs on behalf of President Donald J. Trump, resides the Committee on Environment. Within that committee resides the Subcommittee on Global Change Research (SGCR) in response to the Global Change Research Act of 1990 (P.L. 101-606). The associated U.S. Global Change Research Program (USGCRP), which consists of 13 Federal agencies that collectively contribute more than \$2 billion annually, is charged by the Act³ with developing and coordinating “a comprehensive and integrated United States research program which will assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change.” One important mechanism for meeting this charge is via the quadrennial National Climate Assessment, the most recent version of which was released in late November 2018. The Assessment does not perform research, but rather compiles existing research results and other information to meet its statutory requirement.

2. Last November, the National Science and Technology Council released a decadal report on science and technology for America’s oceans. The report identified five large goals to advance ocean science – one of which is to safeguard human health. It mentions combatting harmful algal blooms as one way to meet that goal. Can you discuss the work that NSTC is doing on harmful algal blooms? As well as provide an update on the progress of meeting that goal?

Answer. As directed by the 2014 amendments to Harmful Algal Bloom and Hypoxia Research and Control Act (HABHRCA), NSTC has established an Interagency Working Group to address this issue, IWG-HABHRCA. The IWG meets bi-weekly to coordinate and convene Federal agencies and their stakeholders to discuss HAB and hypoxia events in the U.S. and to develop action plans for and assessments of these situations. In 2016, the IWG delivered to Congress a research plan and action strategy for the entire U.S., which included an integrated assessment of Great Lakes hypoxia and harmful algal blooms (HABs). They produced a research plan and action strategy for hypoxia and HABs in the Great Lakes in 2017, and a progress report on both products in 2018. The IWG plans to release a scientific assessment of hypoxia and HABs in all U.S. waters by 2024. NOAA and EPA, in coordination with the IWG, are currently developing policies for determining HAB and Hypoxia Events of National Significance (HHENS) and have requested public comments, per the 2017 amendments to HABHRCA, published in January 2019.

3. The Materials Genome Initiative (MGI) was announced in 2011 with an ambitious vision for advanced materials that serve an essential role in economic security, national security, and human well-being. Since the release of the initiative’s strategic plan in 2014, the creation of a “next-generation workforce” to meet today’s materials challenges has been one of four key goals. Can we expect continued support under your leadership for

³Public Law 101-606.

educating and training this workforce to ensure the U.S. maintains its leadership in materials and manufacturing? And can you share OSTP's plan for effectively managing the MGI?

Answer. The MGI inter-agency Subcommittee actively collaborates to collectively advance the goals of the MGI. Several recent and ongoing activities are focused on Goal 4 - Equip the Next-Generation Materials Workforce. For example, NIST supported the 4th annual Materials Research Bootcamp in collaboration with the Workshop on Autonomous Materials Research in August. The Bootcamp introduced attendees to a wide range of machine learning concepts with hands-on exercises using open source software tools applied to a diverse set of materials data. Attendees included 76 students, postdocs, and research scientist from 26 universities, 7 companies and 4 national laboratories. NSF is funding a study by The Minerals, Metals, and Materials Society (TMS) "Creating the Next-Generation Materials Genome Initiative (MGI) Workforce." TMS assembled a study team of 16 experts from industry, academia, and government, led by David McDowell of the Georgia Institute of Technology. Due this fall, the final report will address the current state of the academic curriculum and training approaches of the U.S. workforce to accomplish MGI goals, identify the key MGI skill requirements and needs for individuals entering the workforce, and outline curricula development and training guidelines to improve readiness of current students and the existing professional workforce. This report will inform the future activities of agencies participating in the MGI, in collaboration with the private sector, to advance the workforce needs of this community.

The MGI is managed within the framework of the National Science and Technology Council, which OSTP oversees and the OSTP Director chairs. The MGI Subcommittee, within the Committee on Technology, is a very active inter-agency group that brings together the interests of Federal agencies active in materials design, development, and manufacturing to collaboratively plan and leverage resources and activities. Joint-PI meetings among the agencies promote sharing of data and collaboration within the research community. The MGI also actively engages the private sector and broader community through meetings, workshops, and conferences.

TUESDAY, SEPTEMBER 10, 2019.

**OVERSIGHT HEARING—DOJ COMMUNITY
RELATIONS SERVICE**

WITNESS

GERRI RATLIFF, DEPUTY DIRECTOR, COMMUNITY RELATIONS SERVICE

Mr. SERRANO. Welcome, Mr. Aderholt, and we will welcome the other members. I hope you had a good August recess and thought a lot about me, and I thought a lot about you.

Mr. ADERHOLT. Oh yes. Thank you. Absolutely.

Mr. SERRANO. For the members here who may be surprised to have a hearing today, let me mention our thinking. I want to ensure I will continue our oversight responsibilities this fall so that we can better understand the agencies this subcommittee oversees, and so we can discuss what changes have occurred in these agencies under this administration.

Today we welcome Gerri Ratliff, the deputy director of the Community Relations Service at the Department of Justice, a position she has held since January 2017. Deputy Director Ratliff has a broad prior Federal management experience with the National Science Foundation, the U.S. Citizenship and Immigration Services, and the former Immigration and Naturalization Service. She also served as counsel to the Deputy Attorney General for immigration policy and special counsel for the Justice Department's Office of Legislative Affairs.

The Community Relations Service, or CRS, has a unique mission within the Justice Department. Rather than being focused on law enforcement or the administration of justice, it fills the gap the administration of justice—it fills the gap that exists before those roles come into play. CRS is a small part of the Department of Justice, but it has an important role and helping to reduce tension and find common ground when discrimination, violence, or hate crimes occur in our Nation's communities. CRS serves as America's peacemaker and acts as a first responder to help rebuild bridges and areas beset by fundamental issues involving civil rights violations.

Those efforts range from efforts to reset dialogues between law enforcement and communities after to violence to reacting to hate crimes, to addressing bias in educational systems. Last year alone, CRS mediated in 282 cases across a range of issues at no cost to local communities in order to defuse tensions and promote solutions.

All of this is done with a relatively small budget. In fiscal year 2019, CRS received \$15.5 million. The House bill passed in June, it included an increase of \$1.5 million, bringing the agency to a

total of \$17 million to help the agency address new work in civil rights cold cases.

I believe that CRS' work is unique and needed, especially at this time in our Nation's history. Unfortunately, this administration does not appear to agree with this assessment. They have recommended essentially eliminating this office in their past budget request by trying to bring together CRS within the larger civil rights division. But without proposing an equal increase in funding for that division to accommodate new personnel.

Aside from the serious budgetary impacts of that proposal, that proposal also misconstrues the very different roles that these two parts of DOJ have. The Civil Rights Division has an important role in prosecuting violations of the law. But it is an investigatory body. CRS, on the other hand, is seeking to build trust and propose solutions.

I am thankful that this committee under both Republicans and Democrats has rejected this proposal. I hope that this hearing will be educational and informational for the members here today.

I look forward to hearing more about the work that CRS does on behalf of our Nation and how a proposed funding increase will strengthen your efforts.

With that, let me turn to my friend, Mr. Aderholt, for his comments.

Mr. ADERHOLT. Thank you for yielding. I, too, would like to welcome our witness, Ms. Ratliff, to the Commerce, Justice, Science Subcommittee on Appropriations as you testify regarding the work of the Community Relations Service.

As we will be learning now more about this from our witness, the Community Relations Service, of course, assists State and local communities in the prevention and the resolution of tension, violence, and civil disorders relating to actual or perceived discrimination on the basis of race, color, national origin, gender, gender identity, sexual orientation, religion, and disability.

CRS legacy extends back actually to Selma, Alabama, where it helped maintain peace during two of the three marches by Dr. Martin Luther King.

One thing that I look forward to today is to learn more about the day-to-day operations of CRS and the original offices. The techniques that CRS has found to be most useful in resolving local conflicts, and how CRS works with our State and local law enforcement partners in order to facilitate and improve public understanding of their efforts to make our communities safer.

For fiscal year 2020 the Community Relations Service was once again the subject of consolidation proposal in the President's budget. Rather than request an appropriation for the CRS, the fiscal year 2020 budget, instead proposes to consolidate the functions of CRS into the Civil Rights Division of the Department of Justice. The division responsible for enforcing civil rights laws and consulting with individuals and groups who call upon the Department of Justice in connection to civil right matters.

According to the budget justification, the consolidation would appropriately right-size the Federal Government's role in local conflict resolutions while eliminating duplicative functions and improving efficiency. However, in contrast, the fiscal year 2020 CJS,

Commerce, Justice, Science, and Related Agencies Appropriations Act that was passed by the House this session maintains CRS' independent component within the Department of Justice and increased the funding by \$1.5 million.

Nevertheless, we must continually review the accounts under the jurisdiction of the subcommittee to find the efficiencies and eliminate the duplications. For this reason, I thank the chairman for holding this hearing so that we can learn a little bit more about it today.

Certainly left unaddressed, deep-seated social conflicts can erode public trust and they can threaten the peace and the safety inside our communities.

Accordingly, I deeply appreciate the efforts of our Department of Justice to protect the rights of all individuals, to live free from violence, to also live free from discrimination, and to also be able to worship freely.

So, again, thank you, Ms. Ratliff, for appearing before us today. I look forward to your testimony. And, Mr. Chairman, with that I yield back.

Mr. SERRANO. Thank you, Mr. Aderholt.

Deputy Director, you are now recognized for your comments for your opening statement. Please try to keep it to 5 minutes, and as you know, we will include the full statement in the record. Thank you.

Ms. RATLIFF. Thank you, Mr. Chairman.

Chairman Serrano, Ranking Member Aderholt, and other distinguished members of the subcommittee, thank you for this opportunity to speak with you today. I am pleased to provide an overview of the mission and work of the U.S. Department of Justice Community Relations Service, or CRS. CRS serves as America's peacemaker for communities and conflict by mediating disputes and enhancing community capacity to independently prevent and resolve future conflicts.

CRS was established under Title 10 of the Civil Rights Act of 1964, and its mandate was expanded under the Matthew Shepherd and James Byrd, Jr., Hate Crimes Prevention Act of 2009. CRS works with stakeholders to resolve community conflicts and prevent and respond to alleged violent hate crimes arising from differences of race, color, national origin, gender, gender identity, sexual orientation, religion, or disability.

With our unique mission, CRS is the only Federal agency dedicated to assisting State and local units of government, private and public organizations, law enforcement and community groups, to build capacity to resolve conflicts based on our statutory categories. CRS helps facilitate the development of mutual understanding and agreement as alternatives to violence or litigation.

CRS conciliation specialists are impartial and do not investigate or prosecute. Over the years, CRS has monitored almost every major civil rights related public demonstration across the country, helping to ensure organizers are properly trained to maintain peace during these events, and providing on the ground conciliation support.

Our conciliation specialists share their mediation, facilitation of dialogue, training and consultation expertise, with communities experiencing conflict across the U.S. and in its territories.

CRS staff travel to cities and towns to work directly with stakeholders, and assist them in developing strategies to reduce tensions. Topics of discussion frequently include tensions related to race, color, and national origin; police community relations; perceived hate crimes and bias incidents; tribal conflicts; and protests and demonstrations. The dialogues help communities develop action plans for building trust and strengthening relationships between groups, as well as resolving conflicts in neighborhoods and schools.

CRS' programs include the Bias Incidents and Hate Crimes forums and Protecting Places of Worship forums that convene local and Federal law enforcement and community organizations in educational discussions about hate crime laws and reporting, approaches to combat and respond to bias incidents and hate crimes, and best practices to help communities protect places of worship.

With 16 conciliation specialists and 5 regional directors, CRS has provided services to community groups this year in over 150 cases through the end of the third quarter of this year.

As in prior years, the majority of our cases are based on race, color, and national origin. However, this year cases based on religion have also become an area of focus. For example, CRS has supported communities in 19 instances this year related to anti-semitism from the Tree of Life Synagogue massacre in Pittsburgh to the shooting at a Poway Synagogue in southern California. Incidents such as these increase tensions not only in the local communities in which they occur, but around the country as well.

We anticipate that the trend this year of responding to an increased number of religion-based bias incidents and hate crimes will continue in fiscal year 2020, in addition to our work in our other jurisdictional categories. And, as always, we expect incidents and tensions based on race to comprise the larger share of our work.

Programmatic activities planned for fiscal year 2020 include completing updates to three facilitated dialogue programs and related tools and resources, and a new training course for stakeholders on skills for facilitating multiparty meetings. In terms of program evaluation, we will collect day of session feedback on the content and delivery of all of our trainings and programs, and we plan to pilot an assessment process to measure the longer term impact of our programs, such as capacity building, strengthening police community relations, and the degree to which participants have applied the knowledge and skills learned in the trainings.

These evaluations will aid CRS in the ongoing improvement of our programs and allow the agency to respond to the ever changing needs of our diverse stakeholders.

Thank you for the opportunity to discuss the work of CRS and our commitment to serving communities as America's peacemaker. I look forward to answering any questions you may have.

CRS' PROCESS FOR REQUESTS

Mr. SERRANO. Thank you so much. I would like to start by going over some nuts and bolts of how CRS performs. CRS' conciliation specialists provide their assistance on a voluntary basis at the request of officials or community leaders.

Could you walk the committee through how such requests come in and how CRS decides which to support?

Ms. RATLIFF. Thank you for that question, Mr. Chairman.

First of all, we receive requests from stakeholders for services, we receive referrals from offices like our U.S. Attorneys offices when they see an incident that they think might be appropriate for CRS to look at, and also we proactively identify opportunities to provide services and then can reach out to stakeholders explaining what our mission is and what our programs are, and then working with them if they accept our offer of services.

The way we identify which cases to pursue is really based on priority. Every year there is always going to be more potential cases across the country than any office could address. We also work with communities not just in addressing tensions and conflicts, but communities working to proactively prevent as well as respond to hate crimes.

So we are able to prioritize the cases where we think we will have the most impact, where we think there is an opportunity to build community capacity, we are small. And so part of our approach is helping communities develop the capacity independently in the future to assess and resolve their own tensions to leverage our resources across an even greater spectrum.

So our cases come from stakeholders who are interested in our services where we think we will have the most impact, where there are the greatest tensions, and that is just an evaluation that is carried on at headquarters and the local level.

Mr. SERRANO. But there are cases where you see a need to offer your services and not wait for the folks locally to tell you they need your help?

Ms. RATLIFF. Yes, Mr. Chairman. We are able to proactively reach out. If a community has not worked with us previously, we will offer as a matter of outreach to go to them and describe our mission and what our programs and services are, and often they will then over time work with us to decide if any of our range of services might meet their needs. Some communities are already able to address their needs on their own.

PROACTIVE OUTREACH BY CRS

Mr. SERRANO. Right, because that was the question I had. The engagement usually happens after a hate crime, a police shooting, you know, a conflict at a school, public facilities, after the event takes place, unfortunately.

So we wanted to know how you promote a path to provide proactive support, which is what you started to answer, and if you have any further to say.

Ms. RATLIFF. Thank you, Mr. Chairman.

Yes, we have quite an array of ways that we do our proactive outreach. When we see that local elected officials have turned over

or new city leaders have been appointed, new community leaders have come to the community, we will proactively contact them to introduce ourselves. It is very important that we have reached out ahead of an incident to develop a relationship and trust. So our conciliators are going throughout their region to establish those relationships and renew and strengthen those relationships.

We also have materials on our website. We have conducted webinars to explain our programs, in particular, our Hate Crime forums and Protected Places of Worship programs. We participate in conferences to make presentations about our services or to have a booth with our brochures and even our annual report to Congress that does describe our services and significant cases. We try to take advantage of any opportunity to do that proactive outreach so that relationships are in place before an incident occurs.

Mr. SERRANO. Let me just, not dry this subject up but, so when you say proactive, you said you are making yourself available and known to the community in case they need your help. But do you see an area or you read in the paper something, that there is something brewing, or some accusations have been made, and you step in and say, you know, we can help deal with this.

Ms. RATLIFF. Yes, absolutely, Mr. Chairman. Part of the conciliator's job is to monitor the news, monitor social media, be aware of public sources of information that would give them evidence of where there may be a growing tension in one of the cities in their jurisdiction. And then they will assess and monitor either offsite, by making phone calls, by going onsite, to introduce themselves to the relevant stakeholders or to strengthen the relationships that are already in place.

MEDIATION

Mr. SERRANO. Now, when CRS takes on a role that is mediated, does it reduce the likelihood that litigation might otherwise be pursued?

Ms. RATLIFF. Mr. Chairman, we hope so. There have been cases that we have successfully concluded a mediation agreement and then there was not litigation, and so we would like to say that our work was a part of that reason to avoid the litigation.

PUBLICITY

Mr. SERRANO. Let me just—we are aware that CRS provides its services in a discreet manner that reduces the potential for misunderstanding and avoids unnecessary publicity that might interfere with confidence building and communications. How do you reconcile this with the potential benefits publicizing CRS contributions to reducing conflict in communities, positive advertising, if you will.

Ms. RATLIFF. Mr. Chairman, we do take advantage of, in your words, positive advertising in a way that does not reveal confidential details of our cases. For example, in our annual report we do get waivers from parties before we divulge any details at all, even at a high level about our cases.

When we provide outreach, we do include relevant case summaries where we have been given permission from the parties and

do not reveal details that would identify the particular parties involved, and certainly not specific conversations that occurred.

But there is a lot that we can do and that we do do to try to get the word out about the kinds of cases that we work on, the programs and trainings we offer. Certainly we can discuss and hand out our brochures, and as I mentioned, our webinars, to talk about those services without stepping over the line of confidentiality.

Mr. SERRANO. Thank you. Mr. Aderholt.

Mr. ADERHOLT. Thank you.

CRS DAILY TASKS IN REGIONAL OFFICES DAILY WORK

I understand the Community Relations Service stands ready to offer its conflict resolution service to communities across the U.S., and I know there are examples of CRS having a positive impact on communities, as you have mentioned. Judging from your fiscal year 2018 annual report, CRS responds to a wide variety of isolated conflicts. What is the typical day like at one of your regional or your I would say 10 regional offices, I believe. Is that right?

Ms. RATLIFF. Mr. Aderholt, we have 10 regional offices and four field offices that report to a regional office.

Mr. ADERHOLT. Four field offices. What is a typical day like when they are not actually engaged in a particular dispute resolution and activity on the ground or in a community.

Ms. RATLIFF. Thank you for that question. Most people who are aware of CRS know that we work to diffuse situations of actual conflict, such as a violent demonstration. That is certainly not 40 hours a week of work, and thank goodness it is not. But the bigger bulk of our work involves conflicts that don't include a present potential for violence or actual violence. Our facilitated dialogue programs, our mediations, our trainings, are typically conducted after weeks or months of planning.

So a lot of what our field staff are doing is working with community groups to plan these events that take leg work to be successful.

For example, this year we conducted seven mediations. A mediation is not something that you do in a day. It is successful only after careful planning, working with the parties on the right agenda, and multiple sessions. Our trainings are very similar where we work with a planning group to make sure all the right stakeholders are involved, that the word gets out so we have a successful event, and that there are elements included in the planning that we call a "leave behind".

We don't ever like to do an event that is one session and then go away. We like to leave in place a structure, capacity building, if you will, where a working group or a council is left in place where locally they can then take what we have discussed in the training or the facilitated dialogue, and turn it into actions that are fitting of their local situation that they are empowered to then work on, implementing solutions on their own or with our support to address the tensions that led them to come to us in the first place.

These are activities that again, are not quelling the violence on the street, but are very, very important to addressing underlying tensions, historical tensions. We also conduct a lot of outreach. It

takes time to develop and strengthen relationships that must be in place before we can successfully go to a party when there is an incident and have trust already in place.

We also encourage our facilitators in the field to share their expertise, which they do quite a bit, on panels, Federal, State, and local panels, task forces and working groups that work to increase capacity to reduce tensions and to prevent and respond to hate crimes. And they also share their expertise in meetings with senior government officials, working with the U.S. Attorneys offices, local officials, city mayors, chiefs of police, and others.

CENTRALIZED CRS OFFICE

Mr. ADERHOLT. Thank you. According to your website, CRS has regional and field offices, as we mentioned, that are strategically located throughout the country to maximize availability of CRS services, meet the unique needs of the community they serve, and enable staff to deploy in the communities quickly in times of crisis. Some of these field offices serve a five or more State area.

Couldn't a centralized CRS staff serve a vast majority of these States and the communities just as well.

Ms. RATLIFF. Congressman Aderholt, we have found historically that developing those local relationships before there is an incident is a key way to success. However, wherever we are located, whether centrally or spread out across the United States, CRS staff will work to achieve our mission as efficiently and effectively as possible.

ALLOCATION TO REGIONAL OFFICES

Mr. ADERHOLT. How do you allocate—determine allocation of resources among these regional offices?

Ms. RATLIFF. Congressman Aderholt, first of all, we replace staff who have left through attrition or retirement (when someone has left an office) because we are small. The average number of staff per office currently is two or so, give or take.

Mr. ADERHOLT. Is that in the regional offices or the field offices?

Ms. RATLIFF. Each field office currently has one staff and then our regional offices currently have on average two staff more at other points in our history. So when there is attrition, that becomes a priority.

So as we are able to hire we will replace staff who have left, however, we are always mindful of case load and tension trends. So we also take into account if two regions each have lost a conciliator and we are going to hire one person, we will allocate the new hire to the region where we see by the caseload there is the greater need.

Mr. ADERHOLT. And as you mentioned earlier there are—you have got 10 region offices and four field offices. Correct?

Ms. RATLIFF. Yes, sir.

REGIONAL OFFICE VS. FIELD OFFICE

Mr. ADERHOLT. Now, what is really the role of a regional office as opposed to a field office?

Ms. RATLIFF. Congressman Aderholt, in many ways the roles are the same. The field office enables us to stretch our ability to develop relationships into a large city where the field office is located. For example, in the region that is situated in Atlanta, we have a field office in Miami. The staff in Atlanta are very busy covering their eight State jurisdictions. The population in Miami is such that it justifies having additional staff in our view, dedicated there to develop those relationships, not just in Miami, but throughout Florida, so that when there is an incident staff are close by able to more quickly deploy, and already have those relationships in place.

ALLOCATION OF RESOURCES

Mr. ADERHOLT. And do you know the percentage of your budget that is spent annually on costs associated with travel and deployments?

Ms. RATLIFF. We can get you the specific figure. We do track that and it varies year to year, depending on the tensions and conflicts that the country is experiencing.

REGIONAL OFFICE DEPLOYMENT

Mr. ADERHOLT. And I know you don't have the exact numbers. Do you have an average number of days a year that a CRS staff in the regional office are actually deployed actually in the local community?

Ms. RATLIFF. Again, it does vary significantly year to year based on need, but we could get you specific figures for the last few years if that would be helpful.

CRS ENGAGEMENT WITH COMMUNITY

Mr. ADERHOLT. And then, lastly, when CRS deploys to a particular community that is in conflict or that is perceived to be in conflict, do its specialists seek out and work directly with the stakeholders?

Ms. RATLIFF. Congressman Aderholt, yes, absolutely. Our work is essentially supporting what stakeholders are doing.

Mr. ADERHOLT. And they seek them out?

Ms. RATLIFF. Yes, absolutely. We seek out all of the stakeholders who are related to a tension, whether it is a community group, a neighborhood, the local law enforcement, the local Federal officials, the local elected officials, faith-based leaders, our mission is to neutrally work with all affected parties.

Mr. ADERHOLT. Okay. Thank you, Mr. Chairman.

Mr. SERRANO. Thank you. Mr. Cartwright.

Mr. CARTWRIGHT. Thank you, Mr. Chairman.

And Deputy Director Ratliff, thank you for joining us today and thank you for your work.

CRS ANNUAL REPORT (2018)

I want to start by reviewing some numbers with you, numbers that appeared in your recently published Community Relations Service 2018 Annual Report, that highlights the enormous and growing problem of hate crime in this country.

FBI HATE CRIME STATISTICS REPORT

The FBI's Hate Crime Statistics Report released on November 13, 2018, showed a 17 percent increase in reported hate crimes from 2016 to 2017, including the following: An 18 percent increase in hate crimes related to race, ethnicity, and ancestry. A 23 percent increase in hate crimes related to religion. A 66 percent increase in hate crimes related to disability. A 48 percent increase in hate crimes related to gender. And increases in hate crimes related to sexual orientation and gender identity.

As far as I went with it, to the best of your knowledge, is that an accurate rendition of the statistics in the report?

Ms. RATLIFF. Yes, Congressman, I believe it is.

Mr. CARTWRIGHT. You agree that the increase in hate crimes is a statistically significant figure, and that this is an issue that requires attention from the Department of Justice and Congress?

Ms. RATLIFF. Congressman, I am not a statistician, so I would hesitate to comment on its statistical significance.

Mr. CARTWRIGHT. Okay. Would you agree that it is an issue that requires attention?

Ms. RATLIFF. Well, the Community Relations Service certainly treats it as an issue that requires attention and, so, yes, sir.

Mr. CARTWRIGHT. Okay. Are the trends that I outlined just now, are they acceptable or do they require additional attention and action?

Ms. RATLIFF. Congressman, in the eyes of CRS, our staff, and just through the years, we have worked as America's peacemaker through many turbulent times from the marches in Selma to the post-9/11 backlash against Arab, Muslim, and Sikh communities to the violent demonstrations in Charlottesville in 2017. We have seen turbulence throughout each decade of our existence and we proceed with our work to address the challenges of today as we have done throughout the years.

Mr. CARTWRIGHT. It was a yes or no question. Are the trends I outlined acceptable?

Ms. RATLIFF. Congressman, even one hate crime is not acceptable. So I would say no.

Mr. CARTWRIGHT. Thank you.

CRS ANNUAL REPORT (2018)

Now the 2018 CRS Annual Report also states, quote, "with its unique mission, CRS is the only Federal agency dedicated to assisting State and local units of government, private and public organizations, law enforcement and community groups, to resolve conflicts based on these aspects of identity, whether related to an individual's race, religion, gender, or other statutory category," unquote.

It also states that, quote, "CRS works with community groups to resolve community conflicts and prevent and respond to alleged violent hate crimes arising from differences of race, color, national origin, gender, gender identity, sexual orientation, religion, or disability," and from your testimony this morning, I take it that was very much in line with these statements as well. Correct?

Ms. RATLIFF. Yes, Congressman.

CRS BUDGET ELIMINATION

Mr. CARTWRIGHT. But the administration's fiscal year 2020 budget request eliminated the Community Relations Service and moved the function to the Civil Rights Division. Correct?

Ms. RATLIFF. Congressman, yes.

Mr. CARTWRIGHT. While the community has rejected—excuse me. While this committee has rejected this proposal, if it went through the net result would have been a reduction in staffing from 54 employees to 15 employees, and a budget reduction from \$15.5 million to less than a third of that, \$5 million.

The question is, are your employees busy? Do they have enough work? I assume they must have enough work given the alarming increase in hate crimes reported by the FBI.

Ms. RATLIFF. Congressman, our conciliators are busy. There is always more work than can be done.

Mr. CARTWRIGHT. So if they are busy, why would you want to dramatically reduce their workforce?

Ms. RATLIFF. CRS is committed at any funding level, Congressman, doing all that we can to work with communities who are seeking to reduce tensions and prevent and respond to hate crimes. At any funding level there will be more work that can be done to support communities, and that is why we prioritize the cases where we think we will have the most impact.

Mr. CARTWRIGHT. Well, in light of the worsening statistics that we have seen and the unique role that CRS plays in addressing those issues, what sense does it make for DOJ to gut the programs that are best suited to address hate crimes and violence in our communities?

Ms. RATLIFF. We are committed to working as efficiently and effectively as possible. There are always ways that we can leverage our resources and technology to do even more with what we have. And, again, no matter the year and no matter the funding level, there is more work than any office could do to support communities working on these issues, and at any funding level we must prioritize the cases where we can have the most impact.

Mr. CARTWRIGHT. Last question. Don't you think this sends the wrong message? Cutting funding, cutting employees, cutting the budget for this really important agency?

Ms. RATLIFF. Mr. Congressman, CRS is focused on achieving our mission and fulfilling our mandates.

Mr. CARTWRIGHT. Thank you.

I yield back, Mr. Chairman.

Mr. SERRANO. Ms. Meng.

Ms. MENG. Thank you, Mr. Chairman. And thank you, Director, for being here today.

First, I want to express my appreciation for CRS and the team you have in our home State of New York. Two years ago I held an event at our local Jamaica Muslim center to address the growing concerns of hate crimes and hate related incidents. And CRS played an integral role in addressing a lot of the concerns that came from our constituents.

Additionally, I want to commend you for your collaborative work to develop and launch the DOJ hate crimes website. Hopefully,

that will be very helpful. I want to piggyback a little bit about what my chairman and Mr. Cartwright have talked about, specifically in regards to anti-immigrant sentiment.

INCREASED ANTI-IMMIGRANT BIAS

I wanted to know what specific steps are being taken to address some of this increasing anti-immigrant bias around the country?

Ms. RATLIFF. Congresswoman Meng, immigration status is not one of our jurisdictional categories, however, there of course is overlap with some of our categories. And when an incident is jurisdictional, we will work with the community groups, whether the perception is of a tension related to race, color, or national origin, or under our Hate Crimes Prevention Act jurisdiction, related to preventing or responding to a hate crime.

So throughout our caseload you will see jurisdictional incidents where the community groups may, from their perceptions, think there is an immigration status related issue, and from our perspective we are working with them on our jurisdictional categories.

So that work would include our facilitated dialogues, our trainings, our mediations, our consultations in sharing best practices.

Ms. MENG. Thank you.

DOJ DEPARTMENT SUPPORT

What type of support do you receive from other DOJ divisions to maybe collaborate on strategies to address some of the these. For example, white supremacists, field hate violence, and how is CRS collaborating with local law enforcement around the country to address these issues?

Ms. RATLIFF. Thank you for that question. We do leverage department resources when appropriate. We also work together on department initiatives, including the one you mentioned. Under the Hate Crimes Enforcement and Prevention Initiative, we have played a large role in the development of the hate crimes website as well as community facing hate crimes training that will be piloted next year.

There are times during deployments where we will work with the COPS Office to conduct facilitated dialogues between law enforcement agencies or between a law enforcement agency and community groups dealing with conflict.

Some of the Department of Justice components we would not have reason to work directly with, but we are always coordinating with our colleagues and coworkers to share resources and best practices.

In terms of local law enforcement, many—in fact, most of our cases, the largest slice of our cases—involve in one way or another local law enforcement, so they are always one of our first stops in introducing ourselves, getting their perspective as we are neutral in terms of conflicts, and supporting their needs, sharing best practices that we are aware of, and referring them to other experts as needed, to hear from their perspective directly, and also to support their needs as we support all of our stakeholders' needs.

Ms. MENG. Thank you.

NEWLY UPDATED PROGRAMS

And, finally, I just wanted to ask about two of the more newly updated programs engaging and building partnerships with Muslim Americans and partnerships with Sikh Americans. As you know, these programs include presentations designed to raise cultural awareness about Muslims and Sikhs and share best practices with law enforcement.

I wanted to ask about the current status of those two programs and presentations. Are they being actively deployed? Are the materials publicly available?

Ms. RATLIFF. Thank you for that question as well. The engaging and building partnerships with Muslim Americans and Sikh Americans trainings, actually two parallel trainings, are ones that we recently updated over the last 2 years. We worked with Muslim American and Sikh American groups to advise us on the content. We conducted a focus group of law enforcement because they are the target audience for these trainings to make sure that the content resonated with them and their needs.

And we just recently held the law enforcement focus group, updated the content to meet their needs, and we will now be in fiscal year 2020 rolling out the new content for use across the country when requested.

So far this fiscal year we have facilitated the trainings in Texas and New Jersey, again, conducting evaluations at the end of each session to refine the content. And the model we are using is using a local subject matter expert to be the face of the content.

So, for example, when we are facilitating the Muslim American training, we will use a Muslim American expert who we have trained to present the content and answer questions, and then our conciliator is also present as an overall facilitator and to guide the audience to developing action plans for what actions they can take, based on the training, to better strengthen their own engagement with those populations.

Ms. MENG. Would you be able to share some of these materials and trainings with our committee?

Ms. RATLIFF. Yes, absolutely.

Ms. MENG. Thank you so much. I yield back.

Mr. SERRANO. Thank you. Mr. Crist.

Mr. CRIST. Thank you very much, Mr. Chairman. And, Director, thank you for being with us today. You have incredibly important work to do, and we appreciate you taking the time to speak with us.

FBI REPORT

As Congressman Cartwright mentioned, in your written testimony you state that an FBI report showed that a 17 percent increase in hate crimes has occurred between 2016 and 2017. And, of course, that is just the reported hate crimes.

You also state that CRS anticipates this trend to continue and that your office will be asked to respond to even more occurrences in fiscal year 2020. Given this, would you agree that CRS' work is increasingly important in today's society?

Ms. RATLIFF. Congressman, we believe that our work has been important since the 1960s when we were founded. As the specific nature of the conflicts facing this country have changed with the decades, we have adapted to meet the diverse needs of our stakeholders, but we have felt that each year each decade has brought its own very important challenges, including today.

HATE CRIMES

Mr. CRIST. Does your agency have the ability or the expertise to try to analyze what hate crimes are occurring in our present day society at all? Do you devote any work to that?

Ms. RATLIFF. Congressman, did you say to analyze why they are occurring?

We do not have a unit dedicated to specifically analyzing why hate crimes are occurring. We are always, all of us, seeking best practices and research, working with experts to try to understand the latest research that would inform our programs. But we certainly could not speak as to the source for these hate crimes and bias incidents.

Mr. CRIST. Do you think it would be a good idea to try to learn what some of the causes might be of current hate crimes in America?

Ms. RATLIFF. I think that the causes of hate crimes and bias incidents, there is certainly not one cause I think they are very complex issues that are based on the community, based on the community group affected, based on the locality as to why a hate crime or a bias incident would occur. When there are historical tensions, they also play into perceptions and reactions.

There are agencies, even within the Justice Department, the Office of Justice Programs has a mission that includes research and awarding grants to experts to conduct research.

And I am not an expert on the scope of their grants and research, but as a small agency, we remain focused on our core mission, which is to support communities working to reduce the tensions and respond to hate crimes, and certainly at this time we are not seeking to divert from that mission.

ELIMINATION OF CRS

Mr. CRIST. Can you share with us why you believe the administration has proposed to eliminate your agency?

Ms. RATLIFF. The administration is focused on streamlining and prioritizing efficiency and effectiveness.

Mr. CRIST. Do you think given the recent increase in hate crimes in America that it's a good idea to do away with your agency?

Ms. RATLIFF. At CRS we are focused on advancing our mission, on working on our mandate of impartiality, and supporting community groups.

Mr. CRIST. What is your mission?

Ms. RATLIFF. Our mission under the Civil Rights Act of 1964 is to work with communities that are seeking to reduce tensions and conflicts based on race, color, and national origin.

Our mission was expanded in 2009 with the Hate Crimes Prevention Act to include five other categories: religion, disability, sexual orientation, gender, and gender identity, where we can support

communities who are working on tensions related to those five categories as well as race, color, and national origin, to respond to and prevent violent hate crimes and the perceptions thereof.

EQUAL EMPLOYMENT OPPORTUNITY COMMISSION

Mr. CRIST. Thank you. Are you aware that the Department of Justice has been pressuring the Equal Employment Opportunity Commission to reverse its position that the Civil Rights Act prohibits employment discrimination based on gender identity or sexual orientation?

Ms. RATLIFF. Congressman, I am not aware of the details of that issue.

Mr. CRIST. I didn't ask if you are aware of the details, I was asking if you were aware of it at all.

Ms. RATLIFF. No, I am not, Congressman.

Mr. CRIST. Let me make you aware of it.

Ms. RATLIFF. Thank you, sir.

Mr. CRIST. I am reading from a Bloomberg Law Daily Labor Report posted August 13, 2019. The Trump Justice Department is urging the Federal Employment Rights Agency to change its position and tell the U.S. Supreme Court to rule that businesses can discriminate against transgender employees without violating the law.

So now we are all aware of it. What do you think of that?

Ms. RATLIFF. Congressman, I am focused on supporting CRS' work. We do work with communities addressing transgender related conflicts and tensions. In fact, this fiscal year we have had 12 such cases in States ranging from Florida, Illinois, South Carolina, Tennessee, Michigan, North Carolina, Washington State, Missouri, and DC.

There have been cases, as I am sure you are very well, where a transgender woman has been sexually assaulted, a black transgender woman was fatality shot, another transgender woman was murdered. Those are very concerning cases where we have had the privilege of working with community groups to support their work to prevent and respond to these types of heinous incidents.

Following up on that work, we have just updated a training that we will be piloting in the next few months is for local law enforcement who are interested in strengthening their engagement with transgender communities. It is called Engaging and Building Relationships with Transgender Communities. So this is a very important part of our jurisdiction.

Mr. CRIST. Having said that, and I appreciate you using the adjective heinous in relation to those cases that you are handling and helping with currently, I would have to assume then that if there was a reversal of protecting people of transgender, that that would be equally heinous.

Ms. RATLIFF. Congressman, we are focused on our work.

Mr. CRIST. And that currently is your work, but if the Department of Justice is successful it wouldn't be your work anymore. Is that good or not good?

Ms. RATLIFF. Congressman, we are focused on our work and fulfilling our mission as America's peacemaker and we are committed to that mission.

Mr. CRIST. Thank you.

Mr. SERRANO. Mr. Case.

Mr. CASE. Thank you. And thank you to your staff for your critical work, getting much more critical. Just a couple of kind of logistical questions to understand. You have talked about stakeholders a number of times, who are they? I mean, who can come to you?

Ms. RATLIFF. Congressman, anyone can come to us. We work with Federal, State, and local elected officials, city managers. We work with law enforcement at the Federal, State, and local level. We work with faith-based groups, schools. We would work with civil rights organizations, community groups.

We want to and must work with all groups related to a conflict because as a neutral body we must hear from all sides and equally work with them so that we have all of their trust.

Mr. CASE. And you talked about how U.S. Attorneys are one of your sources. Correct?

Ms. RATLIFF. Yes.

U.S. ATTORNEY ENGAGEMENT

Mr. CASE. What are they bringing to you? I am trying to get to a big picture of—you and your department, CRS, are kind of acute observers, independent observers of the state of our society. So I am trying to use you to understand what you think is happening out there and where the priorities should be.

So U.S. Attorneys, what are they telling you they want you to work on?

Ms. RATLIFF. Well, Congressman, the U.S. Attorneys are, in terms of their intersection with our mission, they certainly are focused on hate crimes, prevention, and enforcement.

The Department, as a priority, of course, is focused on hate crimes, including a department level working group that includes CRS as well as the U.S. Attorneys offices's Civil Rights Division, et cetera.

Mr. CASE. Are they primarily bringing to you hate crimes? Is that their concern, the U.S. Attorneys?

Ms. RATLIFF. U.S. Attorneys will refer hate crime related incidents to us. They also will refer, when they believe it is appropriate, incidents that would fall under our Civil Rights Act jurisdiction. If there is an officer involved shooting, for example, and there is a perception that it was motivated by race, color, or natural origin.

They have at times suggested CFS to the local law enforcement and at the same time suggested that we reach out to offer our services. I think we hear from them related to both of our jurisdictions.

CRS RESOURCES

Mr. CASE. Okay. I think your testimony was that you have covered about 150 cases through 3 quarters of this year. How many more are out there if you would have taken if you had the resources, I mean, just that you would feel credible. Let's say that you could just really take any case that you felt was a priority and that should be taken, what kind of volume are we talking about? Are we talking about 3 times that, 5 times that, 150 about right?

Ms. RATLIFF. Congressman, we are not able to quantify that.

Mr. CASE. I am just for your gut. I am asking for a—I am not asking your to quantify it, I am asking you for what you think. How many things come into the office or that you prioritize that you think, yeah, this would be worth working on through the same timeframe?

Ms. RATLIFF. Congressman, part of the difficulty in answering your question is that there are times when we reach out to a community group and the timing is not right from their perspective to work with us. So I don't know how many cases would fall into that category that we wouldn't have been able—wouldn't have had the opportunity to address anyway.

Mr. CASE. Would you say that there is a lot more demand for what you do or other people do in society than what we are actually doing, is that a better way to answer this or are we about right right now?

Ms. RATLIFF. Congressman, I would say, yes, that has been true each year of our 55 years of existence.

Mr. CASE. Okay. When you sit down among your folks and evaluate your cases and take a look at your cases and look at—I assume that you look at themes within your cases and root causes within your cases and try to extract some bigger picture lessons and initiatives, are there areas where you believe that Federal law is insufficient where you say to yourself, wow, I just wish we had a law that did this? Are there areas of that? Are we deficient in our hate crimes Federal legislation, our civil rights legislation, our race-based legislation?

Ms. RATLIFF. Congressman, that is not something we have analyzed. We have not identified any such areas.

Mr. CASE. Any gut feelings for that? Are there areas where the communities that you work with feel that there is not enough attention from the Federal Government?

Ms. RATLIFF. Congressman, that is something that we can take back to the department.

Mr. CASE. I just think you are perfectly suited to give that kind of advice because you are working independently with a lot of folks who will be very upfront with you about what they think. So that is the reason for my question. I am just trying to get a sense of where should we be hitting here.

AREAS OF CONCERN FOR CRS

So then in the same spirit, you know, you have worked over a number of decades now. If you look out into the future, you have prioritized hate crimes, part of that is statutory and part of that is your observation. You have also identified in your testimony that areas of concern from a religion division perspective are on the rise. Are there one or two areas where you are just saying from your own priorities, yeah, we have got to work in that area a lot more because we have got to get ahead of that?

Ms. RATLIFF. Congressman, we care about all areas of our jurisdiction equally. We are concerned that every year the largest percentage of our cases are not just related to race but related to African American tensions, the overwhelmingly largest percentage of our cases every year since our inception.

We also are concerned that religion-based cases, including anti-semitism-related cases, are rising. We are concerned with the number of hate crimes being committed against LGBTQ individuals, particularly transgender cases.

We are concerned about all of our categories of jurisdiction. We are concerned about disability-related incidents. But even though our numbers are small in that area, we care very much about those cases.

We watch our statistics. We look for trends. We try to respond. At the end of the day, we care about every single case and every case that goes unworked.

Mr. CASE. Understood. Thank you very much.

Mr. SERRANO. I have to say that—and I am not trying to be sarcastic—if we were grading you on being a loyal soldier, you would have done very well today.

Ms. RATLIFF. Thank you, Mr. Chairman.

Mr. SERRANO. Did you almost say Mr. President? No. It would have been a slip.

But we have been around long enough to understand in all administrations what role the White House plays in the budget, and it is clear to this subcommittee on this side—and I venture to say that the other side knows it too—that they are trying to get rid of your agency and that is why they are trying to put it somewhere else.

And you answered the questions the way you were supposed to, but please understand that the people who gave you more money in the budget last time was this subcommittee, in a bipartisan fashion. It was not the intention of the administration to do that. It was their intention to move you and push you out, and we have seen that in many places.

The 2020 request proposed moving CRS functions within the Civil Rights Division. As you know, the House-passed appropriations bill did not support this action. In part, this reflected the view that CRS' mission needs to be expanded, not shrunk; but also that CRS not having a law enforcement or prosecution function does not seem a good fit for the Civil Rights Division, which is expected to carry out those functions and to do so with vigor.

RELATIONSHIP BETWEEN CRS AND CIVIL RIGHTS

What relationship does CRS have with the Civil Rights Division and with other DOJ enforcement agencies, such as the FBI, who investigate crimes such as hate crimes and discrimination? Can you work together or must you be strictly separated so as to keep your credibility as a peacemaker and not a score settler?

Ms. RATLIFF. Mr. Chairman—

CRS MISSION

Mr. SERRANO. Because, by the way, we do see your unique mission or the way the agency has developed it, where you go in and you try to make peace; whereas, we expect other agencies to go in and grab somebody by the neck or by the arm and say, why did you do that, you know, you can't do that.

So how do you answer that question now?

Ms. RATLIFF. Thank you for the question, Mr. Chairman. We do leverage Department resources, where appropriate, as I mentioned earlier. That is mostly on Department-level programmatic initiatives, such as working together to implement the hate crimes website and community-facing hate crimes training.

We do not share confidential details of our cases with other components of the Justice Department. We do at times have appropriate case to coordinate with, for example, as I mentioned before, the COPS Office, when we are both working to facilitate dialogue between local law enforcement and community groups or between law enforcement groups. Those would be cases where we are certainly not divulging any confidential information.

We work with the Civil Rights Division, never in detail on cases, but, for example, if they call us in to support, for example, the announcement of a prosecutorial declination, then we would work with them to support the needs of the community and their understanding of the basis for that decision and working to reduce the potential for violence.

But we would rather fall on our swords than divulge confidential information to any inappropriate source.

CONFIDENTIALITY

Mr. SERRANO. So you do work with these agencies, but there is still information that you don't give them or pass on to them, because you need that information in order to build your trust in the community. Is that it?

Ms. RATLIFF. Yes, Mr. Chairman. We could not do our work. We would have no trust if we were not able to keep our information confidential.

CRS NORTHEASTERN REGIONAL OFFICE AND PUERTO RICO

Mr. SERRANO. Thank you. Does CRS Northeastern Regional Office, based in Manhattan, handle CRS' work in Puerto Rico and the Virgin Islands? In 2017, for example, school officials in Hato Rey, Puerto Rico, requested CRS services to help address community concerns about disparate treatment, based on race and color. How does CRS follow issues in Puerto Rico from such a distance? Is it all done with a team flown from New York?

Ms. RATLIFF. Mr. Chairman, the work in Puerto Rico is very important to us. We had six cases in Puerto Rico in fiscal year 2018. Not only did we have staff volunteer to deploy in support of FEMA for the hurricane recovery efforts, but we also have staff dedicated to the needs that relate to our jurisdiction in Puerto Rico.

For example, most of those cases in fiscal year 2018 had to do with perceptions of disparate access to resources relating to the hurricane recovery. Those were cases where we were able to work with FEMA and the local stakeholders to share information and ensure that access to recovery resources was as fair and equitable as possible.

In addition, the schools in Puerto Rico have asked us to come back, not this year, but as soon as they feel ready, to work with them to address school-based tensions, and we look forward to doing that work.

Mr. SERRANO. So a lot of your work was with FEMA and agencies and such and trying to find out how they were treating Puerto Rico. I mean, we heard about it. We saw it in many cases, but it was hard at times to prove that they were not getting the same fair treatment that they should have been getting and that other people got.

Ms. RATLIFF. Mr. Chairman, in addition, there are often perceptions of disparate access in a chaotic environment, which is just as damaging as actual disparate impact as well. And we work on both categories to try to mitigate those impacts.

CAPACITY OF NORTHEASTERN REGIONAL OFFICE

Mr. SERRANO. Deploying CRS personnel so far away must entail a significant commitment of personnel for a length of time. How does the Northeastern Regional Office ensure it has the capacity to meet demand for its services?

Ms. RATLIFF. Mr. Chairman, our conciliators and regional directors coordinate among themselves to ensure that we are meeting the highest needs. So if there is a case in New York that one of our two conciliators who are located there can't get to because they are meeting other needs within the region, we will, through headquarters, coordinate with the other regions to identify staff to deploy to the region. Our interregional deployments are a tool we use to ensure that we are meeting the highest needs where we can have the biggest impact.

CRS ANNUAL REPORT (2018)

Mr. SERRANO. Going back to FEMA for a second, your 2018 report described the positive role that CRS conciliation specialists served in facilitating FEMA operations in Puerto Rico, particularly with disadvantaged communities suffering from Hurricanes Irma and Maria.

Would you describe that effort as having a lasting impact on FEMA community relations? Is the experience transferrable to other government community areas of potential conflict, you think?

Ms. RATLIFF. Mr. Chairman, yes, absolutely. FEMA showered our staff with praises for the work they did on those deployments, and we do believe there are lessons learned from that activity that we can use elsewhere.

Mr. SERRANO. Thank you.

Mr. Aderholt.

Mr. ADERHOLT. Thank you.

CRS RESOURCES

I understand that CRS plays a role in the Department of Justice's ongoing effort to strengthen relationships between the local communities and law enforcement officials. Could you talk about the resources that CRS uses to help inform its understanding of the police perspective in a conflict between a community and its officers?

Ms. RATLIFF. Thank you for that question, Congressman. One of our newest programs that we piloted last year is called Strengthening Police and Community Partnerships, or SPCP. And it is a fa-

cilitated dialogue program that we have found to be effective when local law enforcement would like to take action to address often historical tension, often around race, but it can be around any of our jurisdictional categories.

So, for example, in fiscal year 2018, we conducted two such programs: One was in Erie, Pennsylvania, and one was in Topeka, Kansas. In those programs, we worked with the local police, and these programs were conducted at their request, bringing in community groups for a day-long session of working together, the community and the local law enforcement, in small groups to identify what was working well in the city, what could be better, reporting out and then switching the groups up, and the last part of the day identifying solutions that then were put into a report and turned over to a council.

The council in both cities is comprised of local law enforcement and officials as well as community group representatives. The council in both cases has been working since that session to implement actions that were identified during the actual day of the dialogue.

For example, I can tell you that the Erie, Pennsylvania, council is still meeting. In fact, I believe they have a meeting next week. They have scheduled training. They are working on a victims' assistance program, and they are asking CRS to support some work in schools to address tensions as well.

ANTIFA

Mr. ADERHOLT. Thank you. According to a New York Times article, the Antifa movement believes that violence is a justifiable form of protest. Has CRS attempted to engage with the members of this community in an effort to prevent their violent acts or hatred they espouse towards law enforcement and people with whom they disagree?

Ms. RATLIFF. Congressman Aderholt, as I have mentioned earlier, part of being neutral is to reach out and be willing to dialogue with all stakeholders. I can tell you, though, that when we at times have reached out to Antifa, they don't return our call.

Mr. ADERHOLT. You have attempted to engage?

Ms. RATLIFF. We have in certain cases, yes, absolutely attempted.

[CLERK'S NOTE.—The Department responded for the record:]

In response to a question from Ranking Member Aderholt, Ms. Ratliff stated that CRS attempted to engage with Antifa groups, but that they "don't return our call." To correct that statement, there are some instances where CRS has successfully engaged with Antifa groups, and they recognize that CRS's focus on reducing the potential for violence serves the interest of all parties.

Mr. ADERHOLT. And as far as training CRS' staff to maintain neutrality, you know, there may be times when they might tend to identify or maybe sympathize with one side over the other in a community conflict. What do you do to try to maintain that neutrality and try to make sure that they are going into it from a neutral stance?

Ms. RATLIFF. We focus on the importance of neutrality, every year. In fact, this summer we had our annual staff conference. And one of the significant activities of the conference, led by our general

counsel and our regional directors, was a panel where we reviewed various case scenarios and discussed neutrality implications and actions and better actions that could be taken to emphasize neutrality. So it is a very important topic to us, and we do weave it into our professional development activities.

CRS STAFF INVOLVEMENT

Mr. ADERHOLT. Are there any activities that CRS staff are advised not to participate in, because they exceed the role of a neutral facilitator?

Ms. RATLIFF. Congressman Aderholt, we have some general guidelines. Much of neutrality is a case-by-case basis, but, for example, we have some very clear guidelines that if a conciliator is at a demonstration, they shouldn't be buying a tee shirt and wearing it or wearing a button. There are some very black-and-white guidelines. But a lot of the challenge of neutrality is not so clear-cut and something that we work at and discuss all the time.

Mr. ADERHOLT. Thank you.

Thank you, Mr. Chairman.

Mr. SERRANO. Thank you.

Mr. Cartwright.

Mr. CARTWRIGHT. Thank you, Mr. Chairman.

CRS DIRECTOR VACANCY

Deputy Director Ratliff, I want to ask you about the vacancy at the top of CRS. According to the Washington Post, the position of Director of CRS is one of 145 key positions in the Federal Government requiring Senate confirmation that has not yet received a formal nomination from the current administration.

We are now nearly 3 years into this administration's term and your director position remains vacant. I suppose that is why you are here instead of a Director to testify.

The question is, what are some of the challenges that you have faced over the past 2 years, given that you are serving, really, in an acting role at CRS? Are there limitations on the Acting Director that are not imposed on a Senate-confirmed Director?

Ms. RATLIFF. Congressman Cartwright, I can't think of any specific limitations other than just time. Many of us at headquarters are serving in more than one position, and covering the bases and making sure that balls don't drop is a challenge that we all face. Every one of us at CRS has multiple duties.

For me, as the deputy, I am focused on strategic planning, keeping the trains running, making sure that the staff have what they need to do their work and supporting them.

Mr. CARTWRIGHT. We certainly thank you for that. I guess my followup question is, can you think of a good reason why a Director has not been nominated?

Ms. RATLIFF. Congressman, I am not aware of the plans in that regard or the reasons behind it.

MISSION OF CRS

Mr. CARTWRIGHT. All right. I want to jump over to a topic the chairman just raised, and that was about the mission of CRS. Ac-

ording to the mission statement itself, it says: The United States Department of Justice community relations service serves as, quote, “America’s peacemaker,” unquote, for communities in conflict by mediating disputes and enhancing community capacity to independently prevent and resolve future conflicts.

And I appreciated your description of your work in Erie, Pennsylvania, in response to Congressman Aderholt’s question.

One of the key elements of the CRS is that it is independent of litigators, as the chairman mentioned, and independent of those who investigate and prosecute crimes within DOJ. And let me tell you why independence is really a key element. According to many advocacy organizations, it is this independence that permits local leaders, like the folks in Erie, to ask for assistance in preventing violence, without fear of instigating lawsuits and/or prosecutions based on the request, and participation in planning and prevention.

CRS BUDGET

Over the past two budget cycles, this administration proposed moving CRS’ functions to the Civil Rights Division while eliminating nearly three-quarters of its staff and two-thirds of its budget, as we have discussed. Putting aside the obvious issues with the staffing and the funding, I want to talk about the wisdom of merging CRS into the Civil Rights Division.

Now, Assistant AG Lee Loftus stated in 2018, quote: “We are very aware that there are some potential issues if you combine them, because there needs to be some segregation between CRS and its responsibilities under the Civil Rights Act and the function that the Civil Rights Division may have in its regular investigative and prosecution responsibilities,” unquote. He also stated, quote: “So when CRS moves in, there is going to have to be some type of segregation so that we don’t cross those lines,” unquote. Now, we are very mindful of that and to the extent that we need different authorizing language in our legislation, that will be part of that fiscal year 2019 budget process that we work out on the Hill, unquote. That was AG Lee Loftus in 2018.

So there seems to be a tacit recognition by the DOJ and this administration that there are serious legal issues with respect to this proposed merger. The overall savings from this proposed move would be \$10 million, which is a lot of money but represents a small fraction of the overall DOJ budget.

My concern is this merger would potentially reduce the efficacy of the CRS by eliminating that key independence from prosecutors. Do you agree with the civil rights advocacy groups that CRS should be a separate component under DOJ and not a part of the Civil Rights Division?

Ms. RATLIFF. Congressman Cartwright, the Department is committed to moving forward if Congress adopts the proposal in a way that preserves CRS’ critical impartiality and need for confidentiality.

Mr. CARTWRIGHT. Well, last question: As Deputy Director of the CRS and really the top person in charge of managing it right now, do you believe that CRS can be as effective with less independence, one-quarter of your current staffing, and one-third of your current budget?

Ms. RATLIFF. I am committed to supporting CRS' work however our agency is structured. We will continue to work as efficiently and effectively as we are able under any scenario.

Mr. CARTWRIGHT. Thank you.

Mr. Chairman, I yield back.

HATE CRIMES

Mr. SERRANO. Thank you. The CRS website notes that 90 percent of hate crimes are violent and that about 48 percent of all hate crimes are motivated by racial bias, yet your website also notes that less than half of all hate crimes are reported to law enforcement.

In our hearing this year with the head of the Civil Rights Division, we discussed the largest barriers to combating hate crimes was underidentification and underreporting. Last year, the Department set up a hate crimes website.

How is CRS helping communities become more aware of the prevalence of such crime and to improve such reporting? Is the website increasing awareness of DOJ's CRS resources?

And secondly, the website only seems to contain resources in English. Given the victims of hate crimes do not always speak English as a first language, what can we do or what are we thinking of doing to deal with that particular issue?

Ms. RATLIFF. Mr. Chairman, that was a lot of questions. I will try to answer all of them, and if I leave one out, please remind me.

I will start with the hate crimes website. There have been over 100,000 visitors to the website since it was launched last year across all 50 States. That is one way we are hoping that awareness is getting out. The website was launched as a phase one, with plans to enhance it as we move forward, including adding information in Spanish in FY2020.

Reporting hate crimes is often a function of trust. CRS focuses many of our programs on setting up opportunities for communities who might not feel trust to network and get to know local law enforcement, so that those relationships are in place and hopefully there will be trust to facilitate reporting.

We also have two educational forums, the Hate Crimes Forum and the Protecting Places of Worship Forum, that include panels of Federal and local law officials often an Assistant U.S. Attorney or the U.S. Attorney even will attend—to talk to the participants, and these would be community members, about what is the Federal hate crime law, is there a State hate crime law, how do you report, what are victim services?

Those are forums that we have conducted throughout the country. Even just this fiscal year we have conducted nine Hate Crime Forums and 14 Protecting Places of Worship Forums. We have just completed guides for how to conduct those forums. They are an A to Z guide for if a community wants to put on a forum without us or even with our help. The guides are a form of capacity building that we will be handing out and making available on our website, so that any community who wants to put on such kinds of educational sessions can do so.

POLICE AND COMMUNITY RELATIONS

Mr. SERRANO. I have one last question: One of the bigger issues in the country has been for a while now but certainly recently more than before is the relationship between the police and the community. And there is so much work that needs to be done there to create a better situation, and many communities are trying to do that. There has to be law enforcement within law enforcement to deal with discrimination cases. There has to be programs of understanding and coming together.

What does your agency—how does your agency deal with that, and what resources are available at DOJ and in your office to reach out to communities on this particular issue?

Ms. RATLIFF. Thank you for the question, Mr. Chairman. As I described with the Erie, Pennsylvania, example, one of our programs that we developed last year is called Strengthening Police and Community Partnerships, or SPCP. It is a program that is customized for some of the scenarios you have described. When there are historical tensions or a recent incident between police and community groups and the police—often there is a new police chief who is willing to try to make a fresh start with the community, we will set up a day-long session. And these are planned not in a vacuum, not just with the police chief, but with a planning group that includes the key community members so there is buy-in and credibility in the session. The structure of the programs is to sit the parties down, to talk through their perceptions of what works and what doesn't in the city, and then what do they think could be done for improvement.

We do not come in and impose solutions. If solutions are not generated locally, based on their understanding of what would work, it cannot be successful. So we are behind the scenes facilitating those discussions, and then we set up a council that will take the solutions that have been identified. We put it in a report. And then they meet, on their own cadence, to implement the solutions that the community and the law enforcement identify.

So this is not just a one day and it is solved session. This is a day session that then lives on through this council that is comprised of law enforcement as well as community group, representatives who then implement solutions that they think will address the issues that were raised. That is one of our programs that is very customized to the scenario you describe.

We also have a similar program called the City-SPIRIT, where if the police issues are just part of a larger range of challenges, we can do a similar facilitated dialogue session that is not just focused on police related issues in the community, but includes the participation of other city officials.

And we also have community dialogues tailored to race and other jurisdictional issues, to enable community groups to come together, express their perceptions, and hopefully build relationships and trust to improve those relationships over time.

Mr. SERRANO. Well, I appreciate that. There is so much that needs to be done in that area, and it is not an easy one at times, but one where there are a lot of people who want the situation to be better, that there is trust in their local police, that there is sup-

port for their local police, but that the local police also respect and understand and not bring any of their personal feelings they may have growing up or something into their job.

So it is a very difficult situation, but one that we must deal with and must resolve. With any community that has a relationship between the police and the community, it just won't work for either side. So thank you.

Mr. Aderholt.

Mr. ADERHOLT. Chairman, I don't have anything else.

Mr. SERRANO. Mr. Cartwright.

Mr. CARTWRIGHT. No more questions.

Mr. SERRANO. Well, we thank you. You are probably glad to hear the last three comments. We thank you for the work you are doing. We hope you understand that our comments are not meant to be critical, but, rather, we have certain beliefs.

And we also understand that you can't get up here and agree with us on why you are not getting more resources and more support and so on. And it is all part of what we are dealing with in this country, trying to deal with a lot of things.

But I personally, from my personal viewpoint and a prerogative I always take on my birthplace, do appreciate the fact that you pay attention to the territories of Puerto Rico and the others. If I accomplish one thing in Congress, it is that little by little it is beginning to change the language. It always was the 50 States, and now you hear a lot of chairmen of committee and ranking members say the 50 States and the territories, because we are one family, and a lot of people seem to forget that.

Thank you so much.

Ms. RATLIFF. Thank you for this opportunity.

Mr. SERRANO. Meeting is adjourned.

[CLERK'S NOTE.—The Department did not answer questions submitted for the record.]

THURSDAY, SEPTEMBER 19, 2019.

OVERSIGHT HEARING: SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) ENGAGEMENT

WITNESSES

KAREN MARRONGELLE, ASSISTANT DIRECTOR FOR EDUCATION AND HUMAN RESOURCES, NATIONAL SCIENCE FOUNDATION

MICHAEL KINCAID, ASSOCIATE ADMINISTRATOR FOR STEM ENGAGEMENT, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Mr. SERRANO. Good morning to all. I would like to welcome to the subcommittee Dr. Karen Marrongelle, Assistant Director of the National Science Foundation for Education and Human Resources; and Michael Kincaid, Associate Administrator for STEM Engagement at NASA.

Both NSF and NASA play important roles within the Federal Government in advancing science, technology, engineering, and mathematics, and efforts to inspire young students to pursue these fields. These partnerships have provided great educational opportunities for students in the STEM disciplines, and have helped maintain American competitiveness and innovation on the world stage.

Notwithstanding the congressional action in providing robust funding for STEM, the administration persists in trying to eliminate or reduce funding for STEM programs both at NASA and NSF respectively.

Since January 2017, there has been a consistent effort to undermine the Federal agencies that make the United States the world leader in science and technology. For example, over the past 3 years NASA's budget request has not prioritized funding for the STEM engagement, requesting just \$37.3 million in 2018 and zero funding in 2019 and 2020. This committee has rejected these proposals and has instead provided healthy levels of funding for popular and effective programs, such as the Space Grant Program, EPSCOR, and MUREP.

In the case of NSF, the Education and Human Resources Directorate has had budget requests with a 14 percent decrease in fiscal year 2018 and 9 percent decrease in fiscal year 2020, and, again, this committee has filled in the gaps and provided robust funding to continue the STEM mission. Advancing STEM is about investing in a better tomorrow; it is about educating our young students in fields that will determine the future of billions of people around the world.

The subcommittee is committed to continue providing the resources necessary to build a workforce for tomorrow, create good-paying jobs at home, and advance scientific progress. We have been very focused on providing robust funding for STEM initiatives to ensure that young men and women of diverse backgrounds have ac-

cess to a STEM education and that our STEM fields fully reflect the great diversity of our nation.

Thank you again to both of you for being here today. Thank you for your service and we look forward to hearing your testimony.

And now I would like to turn to my good friend and colleague Mr. Aderholt, our ranking member.

Mr. ADERHOLT. Thank you for yielding, Mr. Serrano, and thank you for holding this important hearing on STEM and how we can better look at that, and see what is happening in that world and how we can better assist from the appropriations standpoint.

I would like to welcome today's witnesses, of course, Mr. Mike Kincaid and Dr. Karen Marrongelle, to the Commerce, Justice, Science Subcommittee.

Given that NASA and the National Science Foundation are leaders in the Federal STEM efforts, we are tasked with carrying out the President's 5-year STEM strategic plan. And I look forward to hearing how annual funding supports your agencies' STEM programs, how you work in coordination with your Federal partners to not duplicate STEM efforts, and how to address challenges that continue to exist in the STEM fields.

Here on the Commerce, Justice, and Science Subcommittee, we do have a long bipartisan history of supporting STEM, and we aim to improve the quality and effectiveness of the education for students in the STEM fields by promoting engaging learning experiences and unique opportunities for students to contribute to the agencies' scientific initiatives.

We still have a long way to go to address a lot of the barriers and the gaps that exist in the field, but I think we are very proud of the progress that we have made to expose more students, just like in the district I represent in Alabama, to STEM opportunities.

Just recently, I joined with the NASA Administrator, Mr. Bridenstine, at a school in my congressional district, Arab High School in Arab, Alabama, where we toured the school and spoke to students about NASA's support for the student robotic program, and emphasized the very need for STEM education.

STEM education provides a pathway for many high-quality and fulfilling careers, while helping boost the U.S. innovation, economic competitiveness, and national security.

In the United States' race against China for high-tech supremacy, it is essential that we as a nation develop more future scientists and engineers. Our ability to innovate and lead in fields like artificial intelligence, quantum cyber, and nanotechnology depends on our ability to motivate and train today's students. Hopefully, this is exactly what the programs that we are going to be talking about today are doing.

And, finally, speaking of our reference to remain ahead of China in scientific innovation, I would like to—it would be extremely worthwhile for this subcommittee to follow up with a hearing to consider NASA's budget amendment to accelerate the U.S. return to the moon in 2024. A subsequent NASA hearing would be a valuable opportunity to better understand how taxpayer dollars are being spent on human exploration programs, including the development and utilization of the SLS Rocket and the exploration of the upper stage production of Orion capsules, and the extent to which

the agency is well-positioned to receive an additional \$1.6 billion to support the Artemis mission.

As the Trump administration recognizes, the United States is once again in a space race and now the stakes are even higher. And while the United States remains far ahead, China is striving to become a dominant space power. I don't think anyone would deny that. STEM engagement efforts hold the key to many groundbreaking scientific endeavors, not the least of which is the U.S. world-class space program.

So, again, thank you, Mr. Chairman, for your organizing the hearing today, and we look forward to the testimonies of our guests here today and to hear from them, and I yield back with that.

Mr. SERRANO. Thank you, Mr. Aderholt.

Dr. Marrongelle, you are recognized at this time for your statement. We hope you can keep it to 5 minutes. As always, your full statement will be in the record.

Dr. MARRONGELLE. Thank you.

Good morning, Chairman Serrano, Ranking Member Aderholt, and other distinguished members of the subcommittee. My name is Karen Marrongelle and I am the Assistant Director of Education and Human Resources at the National Science Foundation. It is a pleasure to be able to testify before you today on the subject of STEM engagement with a focus on STEM education investments at the NSF.

I joined NSF last October from Portland State University in Oregon, a veterans and nontraditional students-serving institution. As a first-generation college graduate, I am passionate about access and success in higher education, especially for students who have not had opportunities to thrive in the STEM disciplines.

As my colleague from NASA will describe, scientific achievements like the moon landing can be life changing and motivating for people of all ages. We know there is a long road between an initial spark of interest in STEM to a successful career in STEM. At NSF, we want to understand the many roads leading from those initial STEM sparks.

NSF is the only Federal entity charged with supporting education research at all levels, in all science and engineering fields, and in all settings. Combining the best that we know from research about learning and cognition with exciting ideas about how to teach STEM is a winning combination for inspiring and preparing the next-generation STEM workforce.

In this hearing, I hope to convey to you my excitement about STEM education and why I think the work we do at NSF is so important for the future of the nation.

Why is research on STEM education so important? First, it provides the evidence to help ground decisions on what to implement. We need the answers to questions like what are the most effective ways to teach the concept of force? How do we prepare teachers to teach engineering design to students from diverse backgrounds? And questions of particular interest to me as a mathematics educator, why are fractions so difficult to learn, and how can we make mathematics a magnet rather than a stumbling block? Education research will help us get the answers.

For example, in the 1980s, NSF funded pioneering work at Carnegie Mellon University using artificial intelligence to help high school students learn algebra. The tutoring system was tested in a trial involving 146 schools in seven states with more than 18,000 students. Today, Carnegie Learning is a private company providing mathematics tutoring products used by half a million students per year in school districts in at least seven states.

STEM education research can help us to imagine and prepare for the education of the future. NSF currently funds a project at New York University using what we know about the importance of having kids explain concepts during learning, but how difficult this can be for middle school students who don't want to be embarrassed by giving a wrong answer to their peers. In this project, middle school students teach a robot about geometry, while the robot provides expressive feedback and social support. Students refine their own understandings of geometry, while enhancing self-reflection and motivation during problem solving, all with a robot who probably won't make them feel embarrassed by their mistakes.

The robots of the future may revolutionize education because they can be programmed to take advantage of our discoveries about learning and teaching, they can be customized, and they provide safe, nonjudgmental learning environments.

STEM education research also helps us prepare the workforce of the future. Scientists and engineers constantly make discoveries that change the shape of their disciplines, requiring new education and training at every level. NSF's Advanced Technological Education Program focuses on the education of technicians for cutting-edge, high-technology fields such as advanced manufacturing, precision agriculture, biotechnology, and cybersecurity. Our graduate training programs support students working across disciplinary boundaries to solve some of the most challenging problems facing our world today. And this year, with a gift from the Boeing Company, we are tackling how best to re-skill employees through online training.

Finally, education research is key to understanding how we can broaden participation in STEM. NSF is instrumental in uncovering what it takes to keep students on the road to reaching their STEM goals, and we do this by working with and learning from a variety of institutions to paint a picture of what works across the United States. We expect that the comprehensive NSF INCLUDES Program will add to our existing efforts. Its national network already has over 20,000 participants and close to 900 partners. The program is intended to scale up proven practices through partnerships to engage everyone in STEM.

In summary, NSF's investments in education allow us to advance research on teaching and learning, broadening participation, and preparing the STEM workforce. NSF's research portfolio provides the knowledge capital that underpins a broad spectrum of nationwide STEM engagement initiatives at NSF, federally, in schools and institutions of higher education, online, and in libraries, museums, and other learning contexts across the country.

I will be pleased to answer any questions that the members may have. Thank you.

Mr. SERRANO. Thank you for your testimony.

Associate Administrator for STEM Engagement—Mr. Kincaid, you are recognized.

Mr. KINCAID. Thank you, Mr. Chairman.

Chairman Serrano, Ranking Member Aderholt, and members of the committee, I am pleased to have this opportunity to discuss NASA's endeavors in STEM engagement. NASA is committed to achieving its exploration goals and to reigniting America's passion for space science, aeronautics, and space exploration. As NASA continues to move forward with Artemis, we envision students across this nation joining us on that journey. NASA's efforts with students attract the next-generation workforce and stimulate interest in STEM careers across the nation. Similar to Apollo, we envision creating the Artemis generation.

NASA's STEM engagement efforts are part of a larger Federal effort to inspire students to study STEM.

NASA, NSF, and the Office of Science and Technology Policy jointly lead the Committee on STEM Education, known as CoSTEM, which coordinates STEM education efforts across the government. NASA is proud to work with our Federal partners to maximize the impact of these investments in STEM.

Congress passed the America Competes Reauthorization Act of 2010, which directed the Federal Government to establish CoSTEM and required us to develop a Federal STEM education strategic plan every 5 years.

In December 2018, we released a new 5-year strategic plan that focuses on building strong foundations for STEM literacy, increasing diversity, equity, and inclusion in STEM, and preparing the STEM workforce for the future.

NASA's investments in STEM support those goals. Our STEM engagement strategies focus on three areas: creating unique opportunities for students to contribute to NASA's work, building a diverse future workforce by engaging students in authentic learning experiences, and strengthening understanding of STEM by enabling powerful connections to NASA.

NASA's Office of STEM Engagement manages a mission-driven program comprised of four projects, which engages students at all levels and supports institutions. Now I would like to highlight these four projects.

The pictures to the right of me—to the left of me, the right of you—show examples of how thousands of students have engaged with NASA through challenges and competitions. I know you are familiar with Space Grant, with consortia in all 50 states, D.C., and Puerto Rico. Over 1,000 affiliate members engage students in NASA's mission through direct student awards, competitions, challenges, research opportunities, and a variety of student engagement activities. Space Grant is a powerful vehicle to build the Artemis generation across the country.

The Minority University Research and Education Project, known as MUREP, invests in minority-serving institutions via competitive awards. MUREP enhances the research, technology, and academic capabilities of these institutions through multi-year grants providing NASA unique benefits to students who have historically been under-served and under-represented in STEM.

NASA EPSCoR directly contributes to the NASA mission by fostering partnerships among NASA research entities, industry, and academic institutions, while incorporating state priorities and needs. Through competitive awards, NASA EPSCoR bolsters the capacity of institutions that have historically been under-represented in research awards.

Finally, the Next Gen STEM Project was established last year to focus on NASA's efforts to engage K through 12 students and provide support to informal education institutions. We have developed a suite of evidence-based pilot activities that engage middle school students in NASA's mission. Next Gen STEM also makes investments in museums and informal institutions through competitive awards, and supports NASA's Museum Alliance.

NASA STEM engagement investments can make a powerful impact. Last year, our efforts reached over a million students and educators. NASA provided over 32 million in direct financial support to more than 8,000 students in internships and fellowships. Nearly 40 percent of these opportunities were filled by women and 30 percent of our awards went to racial or ethnic minorities.

It truly is an honor to speak with you today and thank you again for this opportunity. I am happy to answer any questions.

[The information follows:]

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September 19, 2019

Statement of
Michael A. Kincaid
Associate Administrator for STEM Engagement
National Aeronautics and Space Administration

before the

Subcommittee on Commerce, Justice, Science, and Related Agencies
Committee on Appropriations
U.S. House of Representatives

Overview

Mr. Chairman and Members of the Subcommittee, I am pleased to have this opportunity to discuss NASA's endeavors in science, technology, engineering, and mathematics (STEM) engagement. NASA is committed to achieving its exploration goals, and to reigniting America's passion for space exploration, innovation and discovery. Our groundbreaking work in science, aeronautics and space technology leads to discovery and societal benefits, and exploration is in our DNA – the desire to discover and inhabit distant worlds, whether across Earthly oceans or vast regions of space. The Artemis Program will bring together the capabilities and resources of our international and commercial partners and demonstrate to young people around the world the power of a unified purpose.

As NASA prepares to land the first woman and the next man on the Moon by 2024, we envision having students across the nation join us in our journey. We envision NASA's direct work with students will attract and engage the Artemis generation – our future aerospace workforce – and stimulate interest in STEM careers across the nation. NASA's unique contributions are vital to attracting the next generation STEM workforce and will further NASA's strategic goals of exploration, science, aeronautics, and space technology. NASA is positioned to make valuable contributions in the Federal sector by providing mission-driven opportunities toward enhancing our nation's STEM literacy, and by helping to build a vibrant and diverse next generation STEM workforce.

To execute our STEM engagement efforts, we leverage our community of talented and dedicated education professionals, and capitalize on our technical workforce, tremendously committed to inspiring and engaging youth and students in STEM. NASA has a portfolio of activities and opportunities dedicated to attracting, engaging and educating students and to support educators and educational institutions across the nation. These range from internships and fellowships, research and development (R&D) opportunities, challenges and competitions, pre-college and

college STEM experiences, virtual learning, educator and faculty support, as well as institutional support. In FY2018, over 820,000 students participated in NASA STEM Engagement activities, from Elementary students to Post-Doctoral scholars, and over 180,000 educators participated in NASA professional development activities.

The involvement of and contributions from NASA's technical workforce are vital to NASA's STEM engagement efforts. NASA scientists, technologists and engineers work and interact with students, serve as mentors, and contribute to a realm of STEM engagement activities and opportunities. There is benefit in establishing a direct connection to the technical workforce as key stakeholders for STEM engagement, specifically to: serve as STEM role models; stimulate and facilitate participation within their respective disciplines; and provide relevant knowledge regarding technical content.

NASA's Office of STEM Engagement (OSTEM) guides the Agency's efforts to inspire and motivate students to pursue careers in STEM. OSTEM leads the strategic guidance, integration of efforts agency-wide, and enables a mission-driven approach through close collaboration with the Mission Directorates. The Office is also responsible for effective management of the appropriated Program and the assessment and evaluation of the agency's portfolio of STEM programs, projects and products.

NASA is working to increase alignment between OSTEM activities and the technical needs of NASA's Mission Directorates through strategic partnerships with Mission Directorates. These partnerships allow students to generate innovative ideas and novel solutions that directly align with the largest technical challenges facing the Agency. One example is Artemis Student Challenges, engaging students in activities designed to contribute to NASA's efforts to return humans to the Moon.

The 2020 Budget proposes termination of funding for the Office of STEM Engagement's portfolio of grants and cooperative agreements and redirects funding to NASA's core mission of exploration. The Budget continues internships, fellowships, and student STEM engagement activities funded by NASA Mission Directorates.

STEM Engagement Program

NASA's OSTEM is accountable for implementing the funding provided by Congress in FY 2019. These appropriated funds are comprised of four projects: Space Grant (\$44M); Established Program to Stimulate Competitive Research (EPSCoR) (\$21M); Minority University Research and Education Project (MUREP) (\$33M); and, Next Gen STEM (\$12M). These four projects invest in a variety of endeavors involving direct support to students, support to universities and educational institutions, including museums and other informal education organizations. The projects also provide a spectrum of research and student opportunities.

Space Grant

Space Grant works to expand opportunities for students to understand and participate in NASA's aeronautics and space projects by supporting and enhancing science and engineering education, research, and outreach efforts. Space Grant is a national network of 52 Consortia with over

1,000 affiliate members involving colleges and universities, museums and science centers, and aerospace industry partners from across the country.

EPSCoR

EPSCoR establishes partnerships with higher education institutions that effect lasting improvements in a state's or region's research infrastructure, R&D capacity and hence, its national R&D competitiveness. Five Federal agencies conduct EPSCoR programs, including NASA. NASA's involvement in EPSCoR is directed at the parts of the country that have not, in the past, participated equably in competitive aerospace-related research activities. Twenty-five states, Puerto Rico, and the U.S. Virgin Islands and Guam currently participate. (We are now at 28 jurisdictions)

In 2019, NASA EPSCoR partnered with the Mission Directorates to make substantive investments in mission-driven R&D competitive opportunities. These included research awards in a wide variety of technical fields across NASA as well as International Space Station (ISS) Flight Opportunity Awards that enable research opportunities in low Earth orbit.

MUREP

Through MUREP, NASA provides financial assistance via competitive awards to Minority Serving Institutions (MSIs), including Historically Black Colleges and Universities, Hispanic Serving Institutions, Asian American and Native American Pacific Islander Serving Institutions, Tribal Colleges and Universities, and eligible community colleges, as required by the MSI-focused Executive Orders. These institutions recruit and retain underrepresented and underserved students, including women and girls, and persons with disabilities, into STEM fields. MUREP investments assist faculty and students in research and provide authentic STEM engagement opportunities related to NASA missions.

Next Gen STEM

Next Gen STEM focuses on NASA's efforts to engage kindergarten through grade 12 (K-12) students and provide support to informal educational institutions. It has developed a suite of evidence-based pilot activities to engage middle school students in NASA's mission content. Next Gen STEM also makes significant investments in museums and informal institutions. These include a competitive award program called Teams Engaging Affiliated Museums and Informal Institutions (TEAM II) for museums and science centers, providing inquiry- and/or experiential-based educational opportunities in direct alignment with major NASA missions for students in grades 4-8. The TEAM II 2019 solicitation call for proposals tied to NASA's Moon to Mars efforts, with proposal content directly aligned with major NASA technology and mission efforts. Next Gen STEM also funds the NASA Museum Alliance, which has over 1,200 member organizations across the U.S. and over 130 outside the U.S. in 37 countries.

NASA Internships and Fellowships

NASA internships provide unique NASA research and development work experiences for high school, undergraduate, and graduate students. Funding for these internships comes from across

the Agency, depending on work the interns would complete during their term. Interns work alongside a NASA mentor and other subject matter experts in their field, contributing to an important project and being fully involved with their team. These opportunities leverage the Agency's unique missions and programs to enhance and increase the capability, diversity, and size of the nation's future STEM workforce.

In FY 2018, NASA provided 8,005 internships and fellowships to 7,357 higher education students across all institutional categories and levels. These significant awards provided a total of over \$14M in direct financial support to higher education students. Some recent statistics show that 30.2 percent of higher education internships and fellowships were awarded to racially or ethnically underrepresented student participants, compared to 24.5 percent for the national average of STEM degree enrollees. Additionally, 39.5 percent of the Agency's higher education internships and fellowship positions were filled by women.

NASA STEM Partnerships

NASA collaborators, funded and unfunded, are located in all 50 states, the District of Columbia, Guam, Puerto Rico, and the U.S. Virgin Islands. Collaborators include government agencies, industry, formal and informal education institutions including museums, science centers, planetariums, and youth-serving organizations, non-profit, and other education organizations. Collaborators extend the reach of NASA STEM engagement opportunities. In FY 2018, OSTEM collaborated with 1,695 institutions and organizations.

A few recent partnerships include Microsoft's Hacking STEM team to develop a series of standards-aligned lesson plans for middle and high school students and a collaboration with Peanuts Worldwide in the development of STEM-based curriculum for grades K-5, leveraging an existing Space Act Agreement to bring Snoopy into the modern day. The Peanuts lessons focused on NASA's deep space exploration objectives and interactive ways to celebrate the 50th anniversary of humans first setting foot on the moon.

NASA's Role in the Federal STEM Plan

NASA plays a leading role in the federal STEM community through its leadership of the National Science and Technology Council's Committee on STEM Education (CoSTEM) and its subcommittee, Federal Coordination in STEM Education (FC-STEM). NASA serves as co-chair of both the Committee and Subcommittee, in collaboration with the NSF and the White House Office of Science and Technology Policy. NASA representatives also serve on FC-STEM's Interagency Working Groups (IWGs), which are responsible for implementing specific sections of the CoSTEM strategic plan.

At NASA, we are excited that members of the IWG on Inclusion in STEM are supporting a partnership with the NSF Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (INCLUDES) initiative. It is focused on broadening participation at-scale through networked impact. NASA, like many mission agencies, stands to benefit if we are better able to identify, foster, and retain STEM talent from diverse backgrounds and perspectives, but NASA cannot achieve this goal alone. We hope this

project will not only serve NASA's need for a well-trained and creative engineering workforce, but will also support the work of other federal agencies and the private sector that are in need of engineers who bring unique ideas and perspectives to the workplace.

Conclusion

NASA's work serves as an inspiring example of what humankind can do when it comes together to achieve a common goal for the common good. While visiting Georgia Tech in Atlanta last July, NASA Administrator Bridenstine said, "When we partner with a university, [...] the students actually develop the technology that we fly to the Moon. And then, when they graduate, not only do they have the educational background, but they have the hands-on experience that we can take advantage of and put them right to work." We bring new knowledge and opportunities and inspire the next generation. Inspiring an Artemis generation will help us successfully cultivate new talent for the STEM careers of tomorrow. Our efforts will draw on insights and efforts from all across America, engaging the brightest minds of academia, businesses of all sizes and types and a generation of young professionals joining us at the beginning of their careers. Building on these lessons, NASA will take the next giant leap in human exploration and launch a new generation in space.

Thank you Mr. Chairman and Members of the Subcommittee. I would be pleased to answer any questions you may have.

Mr. SERRANO. Thank you. My first question is for both. The reason we are holding this hearing is because the administration's budget request for STEM education programs are wholly inadequate to our nation's needs.

The fiscal year 2020 budget proposals for NASA and NSF include enormous cuts in STEM education funding. At NASA, the budget proposal included eliminating STEM education programs and at NSF your proposal included a cut of \$87 million from the Education and Human Resources account.

If the budget request was to be enacted, what impact would that have on the STEM workforce capacity building at undergraduate universities and K-to-12 STEM education for both?

Mr. KINCAID. I will go first, okay.

Chairman, thank you for the question. You know, the Office of STEM Engagement is just one part of NASA's effort to develop the next generation of the workforce. So we are very concerned about making sure that we are developing tomorrow's engineers and scientists, and we use NASA's missions to inspire kids in all different ways.

It is true that we had to make some difficult choices in the budget process this year, but we do understand and fully appreciate that Congress has a very strong opinion about these programs and we make it a priority to implement that to the best of our ability. We do appreciate the broad bipartisan support that we enjoy and we hope to continue to merit that support in the future.

Mr. SERRANO. So you were consulted, obviously, then in these cuts—

Mr. KINCAID. I was aware—

Mr. SERRANO [continuing]. In reaching these cuts or you were aware?

Mr. KINCAID [continuing]. I was aware of the cuts.

Mr. SERRANO. But just the Administrator in that case was consulted? Or it was just sent down the way it usually happens?

Mr. KINCAID. I am the Associate Administrator for STEM Engagement, it is my job to implement the work that you guys give us and the appropriations. We are set up to implement the funds that you will choose to appropriate for us.

Mr. SERRANO. Well said. [Laughter.]

Mr. KINCAID. Thank you.

Dr. MARRONGELLE. At NSF, similar to NASA, a reduction in our budget in EHR will result in fewer awards that we will be able to make, fewer innovations that we will be able to fund, fewer discoveries that we will be able to make.

That said, with the generous fiscal year 2019 budget that we were given, I am very pleased at how responsibly we were able to allocate those funds and the number of projects that we were able to fund.

For instance, we were able to add an alliance project in our NSF INCLUDES network this year based at the University of Pittsburgh, which is tackling a really interesting problem. We have increased the number of pre-college programs, especially for inner city minority youth, who take part in those programs and are successful and become interested in STEM, but we have realized that when they go to gain admission to colleges in their localities, they

are having trouble gaining college admission. University of Pittsburgh recognized this problem and has now developed a national network to figure out how to credential pre-college programs and overcome this barrier, so that we can keep those kids on track to achieving their STEM dreams.

It is projects like these that with whatever budget money we receive we are going to be able to continue to do this work, we will be able to do less of it with a lower budget.

Mr. SERRANO. Let me as a follow-up ask, is this simply a budget gimmick? Does NASA and NSF leadership expect the committee to backfill these major gaps each year?

Mr. KINCAID. I am not sure that I can answer on behalf of NASA leadership. You know, we are here to talk to you about the work that we do and the—

Mr. SERRANO. Well, we can answer from our side. I mean, the reason you alluded to a generous increase is because this Chairman and Mr. Aderholt and our leadership agree in helping NASA and NSF, especially in the STEM field, and we would like to see every so often you folks initiating the asking rather than us filling the holes that have been left by some other people.

But we know how things happen around here. Just know that on this side of the room you have people that want to help, but we need help over there also in making the case why you need the money we are giving you, because these days—and I am not trying to be political at this hearing, but Mr. Aderholt knows that I don't do that—but these days, to build a wall, money could come from anywhere, so you have to be making an argument all the time on behalf of what you have and what you need.

Mr. Kincaid, the same question for you and you have answered already, so I don't want you to think that I was just praising the doctor for what she said, we want you to also be an advocate and a cheerleader.

Congress has robustly funded four major programs, Mr. Kincaid, the STEM Engagement Appropriation; the National Space Grant College and Fellowship Program; the Established Program to Stimulate Competitive Research (EPSCoR); the Minority University Research and Education Project; and the STEM Education and Accountability Project. Each of these programs inspire youths to pursue the fields to advance science, technology, engineering, and mathematics.

Are these opportunities fairly disseminated and can you give us examples of how each are administered?

Mr. KINCAID. Chairman Serrano, thank you for the question, it is a great question. And I think it was alluded to, the Space Grant is a really powerful element of that opportunity. The fact that Congress has directed us to create consortiums in all 50 states, the District of Columbia, and Puerto Rico enables us to make sure that we are meeting local needs in those states. Space Grant works together to bring affiliates it could be higher education institutions, museums, science centers together to provide opportunities.

We also look to Space Grant to help us make sure that EPSCoR institutions that are eligible for EPSCoR funding, as well as minority-serving institutions, in those states are able to access the opportunities that NASA has. We do put a premium on making sure that

we are reaching all segments of our community, because we really do in order to secure and we talked about wanting to improve the diversity of this future.

Mr. SERRANO. Doctor, let me give you a follow-up question before I turn to Mr. Aderholt. Do you feel that there are gaps in existing programs that should be addressed? That is, are the STEM education needs in our country that NSF could potentially help address, but which are currently outside the scope of NSF's existing STEM education programs?

Dr. MARRONGELLE. Thank you for the question. I am very proud of the work that we do through a variety of our programs. We reach students from infancy through to working adults, we work in formal settings and schools in all sorts of colleges and universities, from community colleges to liberal arts colleges to research-intensive universities, and then we do quite a bit of work outside the formal school setting. Work with museums, with television programs, work to get the word about STEM out and really reach the broadest population possible.

We have, as you know, programs that focus on specific under-represented groups of students and institutions. We have programs through HBCU-up, through tribal colleges and universities, our new Hispanic-serving institutions program. Those institutions can and do achieve awards at NSF through the whole suite of programs that we offer at the Foundation.

Where we have gaps is really in the number of questions that are out there about effective ways of teaching and continuing to evolve what we know about how people learn. We have those questions that remain that span all groups of students of all ages, of all geographic locations, and those are the questions that oftentimes we just don't get the full and complete answers to.

Mr. SERRANO. Thank you, thank you to both.

Mr. Aderholt.

Mr. ADERHOLT. Thank you. And these questions will be directed to both of you as well.

Studies have shown that STEM education can provide workers with better employment opportunities, of course, wages that are higher and often double the national average, but there are millions of students in rural parts of America that face barriers to having access to high-quality STEM education. Some of the barriers would include teacher retention, shortage of mathematics and science teachers, inadequate resources, limited access to broadband services, just to name a few.

In your opinion, what do you believe is the biggest barrier students in rural areas face in having access to high-quality STEM education?

Dr. MARRONGELLE. This is a great question and thank you for it. We have been funding a lot in the arena of rural STEM education. In a recent review of our portfolio, we have some 350 projects that, in some way, are looking at how STEM education is being implemented in rural communities and the specific challenges.

I just came from a meeting yesterday at the Education Commission of the States where I heard a lot from educators at the State level who have particular concerns around ensuring access to STEM for rural students.

As you highlighted, some of the major challenges are teacher recruitment and retention and teacher recruitment and retention in STEM subject matter. Recruiting a mathematics teacher or a science teacher to go to and stay in rural communities is one of the great challenges.

Technology can also provide a challenge. It can provide opportunities, but depending on broadband access, that can also provide a challenge.

We have several projects at NSF that are specifically looking at how we can address that challenge and how we can offer out-of-classroom support for students, as well. We found that partnering with libraries in rural communities, community groups, community centers, 4-H clubs; these are ways that we can get STEM professionals who are embedded in the community, have STEM understandings and knowledge to provide, to get them connected with kids outside of the classroom as we continue to work on the problem of recruiting and retaining teachers in rural areas.

Mr. ADERHOLT. All right.

Mr. KINCAID. I would add to what Karen said by just talking a little bit about some of NASA's activities. Again, I would refer back to Space Grant. The fact that it is in every state allows us to meet the needs of students wherever they might be and asking them to bring together affiliates, consortiums of organizations together in a state to make a difference, I think, is a key aspect.

Part of why it is key is that we can show up with NASA content that they can distribute. I look at something like NASA STEMonstrations. These are start videos that were produced on-board the International Space Station and they are for use in teachers' classrooms to understand complex physics and science kinds of concepts. For us to be able to provide real-life examples that are very visual for students to be able to see is a real opportunity that we can partner with our other Federal partners to get that information out there.

Thanks for the question.

Mr. ADERHOLT. What are your Agencies doing to provide more opportunities in rural areas to broaden STEM programs on a nationwide basis and how do you evaluate the effectiveness of the programs in the initiative that you did mention?

Mr. KINCAID. I will start by saying that evaluation and trying to make sure that what we are doing makes sense is really a key part. I stepped into this role two and a half years ago and it was an area that was probably not our strength and so I actually called Karen's predecessor and said, You know, the NSF has so much more experience in evaluation of basic research of education. They have truly been an invaluable partner to us to be able to come over, spend time with them, take some lessons learned from them, and I think there has been some opportunities for us to collaborate and learn from each other.

Evaluation is critical. Space Grants and EPSCoR, MUREP, each of our grantees helping us provide the data of the implications and impacts they are making is a critical element of the appropriation that you sent us.

Dr. MARRONGELLE. And just to add on to what Mike was describing, the heart and soul of what we do at NSF is we aim to under-

stand what is working for whom, under what conditions. Any projects, any of the 350 projects that I mentioned, we are gleaning information from those projects to understand where are the projects making a difference and if they are not making a difference, what went wrong and what information can be shared out about, Don't go down that road, but instead, try this because this has been a proven practice.

We love partnering with NASA, and other Federal agencies on answering those fundamental questions and getting the information out.

Mr. ADERHOLT. Last December, the administration released its 5-year strategic plan for STEM education and it was titled, "Charting a Course for Success: America's Strategy for STEM Education." I understand the plan called for building strong foundations for STEM literacy, increasing diversity, as you have already mentioned, an inclusion in STEM and preparing for STEM workforce for the future.

As part of this 5-year STEM initiative, you both serve as co-chairs on the subcommittee on Federal Coordination in STEM Education and I think it is commonly called "FC-STEM." How does the annual NSF and NASA funding help carry out this 5-year plan and assist you in your role on the FC-STEM?

Mr. KINCAID. Thank you, Chairman, for the question, and yes, Karen I visit virtually every Friday morning. We talk about FC-STEM and what we are doing and how we can work, not just our two Agencies, but all the Agencies together. I have got to tell you that these last two years, it has been exciting to see the Agencies wanting to come together. We have unique aspects. There are things that we do that are unique to us, but there are opportunities where we can collaborate and work with others and find out about things that I may not know about in my area that they are working on that we can partner with.

I am excited about where we can go with this. It is, certainly, when we looked at our three overarching strategies for STEM engagement and we wrote those before the new 5-year plan came out, we were really gratified to see that they just dovetailed very nicely. We talked about diverse future workforces, and making sure that students were building, enabling contributions from our students into NASA's workforce.

Dr. MARRONGELLE. Yes. It has been really amazing to work with Mike and all the Federal partners on this plan. I started in October, so when I came in, the plan was just getting finalized and I was really pleased to learn that NSF staff, as I'm sure NASA staff, were really instrumental in the development of the plan. We did get a lot of public input into what should be in the plan.

When I read the plan, there is NSF fingerprints all over it, which means that it is—it dovetails very nicely with the programs that we have. It also, then, enables us to make further tweaks to the existing programs to better align with what's in the plan.

You know, everything at NSF that we do fits into one of the 3 goals that you have just described. This really is a blueprint for our work. It describes the work that we do, and as we move forward to implementation, we have 5 inner-agency workgroups that are set up that are rolling out how the Federal agencies are responding to

the plan, how we are doing it in a coordinated way where we are not overlapping with each other, but rather, drawing on each other's strengths. It is really exciting work to be part of and to see how this is going to make a difference. It is already making a difference for the work that we are doing for the Nation.

Mr. ADERHOLT. According to information that we received, the annual funding for proposals for STEM education are typically in the range of \$2.8 billion to \$3.4 billion. Given that this is a significant Federal investment, how is FC-STEM working to ensure that Federal STEM efforts are not duplicated?

Dr. MARRONGELLE. This is part of the interagency workgroup agenda that I described. Because we are meeting regularly, as Mike described—leadership for FC-STEM meets weekly. We meet with FC-STEM monthly. We have regular, ongoing conversations about what are the unique aspects of our Federal agencies and our unique contributions to the STEM Education Federal Portfolio. Where are places that we can partner to strengthen ties and ensure that the investments are widespread, and look for places where there might be duplication, but more importantly, where there are opportunities for collaboration.

As an example, the NSF INCLUDES National Network recently had 5 Federal agencies join that network. Mike can describe what NASA is doing in that arena, but it is really exciting because we are ensuring that as we take a collective approach to broadening participation of STEM throughout the nation, it is not just NSF on-board, and we are able to reach communities by partnering with NASA or the Department of Education or NOAA or NIH that, otherwise, we would not have had the chance to reach those communities to understand and learn from them and get the word out to a broader audience.

Mr. KINCAID. I would add to Karen's statement by saying that, as she mentioned, one of the five IWGs (Interagency Working Groups) is looking at transparency and accountability. While our team that looks at evaluation and making sure the work we are doing is making a difference, we really have learned a lot not only from NSF, but from those regular conversations.

You know, when you talked about how much money the Federal Government pays, the more we can learn from each other and not try to evaluate in our individual spaces, I think we can be more efficient and truly more effective to build the workforce that we talk about.

As for NSF INCLUDES, you know, there is a number of things that we are working on together and as I have dug into NSF INCLUDES, what's interesting is they are looking at networks of organizations that already exist that we want to help make stronger to really broaden participation in our nation. And for NASA, those line up perfectly with our goals. To be able to have our network interact and leverage NSF's network, I think, can only benefit both us and NSF and the community. I am pleased to be part of that.

Mr. ADERHOLT. Okay. Thank you, Mr. Chairman.

Mr. SERRANO. Thank you.

Mr. Cartwright.

Mr. CARTWRIGHT. Thank you, Mr. Chairman.

And, Dr. Marrongelle and Mr. Kincaid, thank you for being here and thank you for your testimony.

One of the essential roles of NSF and NASA and our entire Government is in promoting STEM education is to inspire the next generation about science, to show them how important science is, and how much we value it as a society. What we do here in government, with respect to science matters. There are subtle and “not so subtle” messages that our Nation’s leaders send to our citizens in our treatment of the scientific community and how we make policy and funding decisions related to science.

When the administration’s budget slashes funding in key research areas from studies of our bee pollination crisis to the impact of mining, that sends the wrong message about how we value science here in the United States. When scientists across the government resign in protest, citing, this administration’s systemic suppression of climate-change research, that sends a clear message about whether the Government accepts widely understood scientific conclusions regarding the connection between human activity and climate change. It sends a message that politics will be valued over science and that the administration does not want to engage with science that fails to agree with its stated policy objectives.

I want to ask some quick questions, and this doesn’t even require a yes-or-no answer, just raise your hand if you agree, okay. Number one: Do you agree that scientific research should be conducted free from improper, political, and outside influence?

It is a “raise your hand” question.

Dr. MARRONGELLE. [Witness raises hand.]

Mr. KINCAID. [Witness raises hand.]

Mr. CARTWRIGHT. Oh, good, I knew you could do it.

Number two: Do you agree that Federal agencies have an important responsibility to set a standard with respect to integrity of scientific research and its results?

Dr. MARRONGELLE. [Witness raises hand.]

Mr. KINCAID. [Witness raises hand.]

Mr. CARTWRIGHT. Good. I am proud of you so far.

Do you believe that in a potentially life-or-death situation, where the attention of the country is focused on our scientists, this would be an especially important time to protect scientific integrity?

Mr. KINCAID. [Witness raises hand.]

Dr. MARRONGELLE. [Witness raises hand.]

Mr. CARTWRIGHT. Let the record reflect the witnesses raised their hands in the affirmative to all three questions. Look, you are here at the CJS Subcommittee hearing room and they provide us with equipment here; they give us pencils, they give us highlighters. One thing they don’t give us is black Sharpies, okay. And we can all roll our eyes at a President trying to cover up his misinformation with a Sharpie, and those memes were a lot of fun, too, were not they?

But the pressure on our scientific agencies to be complicit in this farce and reenforce false and dangerous information is what really disturbs me. The lack of will by scientists to stand up for the truth in science was disheartening.

Now, I know it would have been immensely difficult to speak the truth in the face of the Secretary of Commerce and the White

House Chief of Staff threatening to fire you. I know that. An NOAA meteorologist anonymously commented on the agency's attempt at self-censorship, "This is the first time I have felt pressure from above to not say what truly is the forecast. One of the things we train on is to dispel inaccurate rumors and, ultimately, that is what was occurring."

NOAA's chief scientists called NOAA's response political and a danger to public health and safety—NOAA's chief scientists.

Look, we need to build faith in our scientists so people trust them. They trust weather reports. They trust vaccines. They trust climate science.

What NOAA did in response to political pressure hurts faith in science as an institution and I fear things like that will damage the appeal of science as a career to the next generation. We need brave people to do what is right. Now, if either of you are asked to misrepresent science for political reasons, would you make a different choice from that made at NOAA? How would you handle the situation?

Dr. Marrongelle.

Dr. MARRONGELLE. Thank you for your question. We stay true to the science that we do at NSF. We are about basic, fundamental scientific research and we enable this basic research to be done throughout the United States. We make incredible discoveries like the black hole discovery just this summer. We also, on a ship that involved students aboard, discovered microplastics in the ice in the Arctic, and we continue to support the research that goes on and we will continue to do that, as is our mission at the National Science Foundation.

In the education and human resources directorate, we continue to get the word out about those scientific discoveries and the importance of STEM education and the excitement of doing science and engineering work throughout the country.

Mr. CARTWRIGHT. Mr. Kincaid, please?

Mr. KINCAID. Your question caused me to reflect. Thirty-two years ago, I started at the Johnson Space Center as a human resource person. I am not a scientist. I am not an engineer. On day one, they talked about what we do matters to humans in space, and so the work that we do is important.

From the very beginning, we speak up if we see something that doesn't make sense. I feel like NASA and NASA leadership has continued to set a standard throughout my career that we do what's right and we bring you the data. We bring you information that you and other decision-makers can use.

Mr. CARTWRIGHT. I can tell you my questions are making you uncomfortable and you should be uncomfortable.

Do you believe that scientists, particularly those whose work has immediate life-and-death consequences, brazenly misleading the public could have long-term impacts on public perception of science?

Mr. KINCAID. I didn't understand the first part of your question. I'm sorry.

Mr. CARTWRIGHT. I will read it again.

Do you believe that scientists, particularly those whose work has immediate life-and-death consequences, brazenly misleading the

public could have long-term impacts on public perception of science?

Dr. MARRONGELLE. I think that is possible. I think there is a lot about public perception of science that we still don't know about, that we are still finding out. The answers to how the public views science, how the public consumes science, how the public takes the findings of science and makes decisions about their daily lives and the choices that they make. This is an open question that we continue to try to understand and explore no matter the environments, within which we are currently operating.

Mr. CARTWRIGHT. Will you both commit to standing up for scientific integrity, even in the face of political pressure?

Dr. MARRONGELLE. Absolutely.

Mr. CARTWRIGHT. Thank you.

I yield back, Mr. Chairman.

Mr. SERRANO. Thank you.

Mrs. Roby.

Mrs. ROBY. Well, good morning. You get a softball from me. [Laughter.]

You know, I have two kids, 14 and 10, and it is crazy how, you know, children and their skills seem almost innate when it comes to technology with a tablet or a phone or whatever it may be. I mean, I know if I get stuck, I just hand it to them and say, Figure this out for me.

And so, you know, we have this workforce Gen Z, and my kids, and their generation, and I just want to know, as it relates to STEM jobs and helping push children in that direction—here's the softball—what can we do better? And I'd like to hear from both of you.

Dr. MARRONGELLE. Sure. Thank you for the question. Yes, there is a lot that we are currently doing and there is a lot that we could do better. I also have a 9-year-old, so I understand exactly where you are coming from.

We have been funding several projects through the Computer Science for All program that are equipping today's teachers with information about computer science, computing, and technology, both at the elementary levels, K through 8, and then at the high school levels. High school, we get more intensive training with teachers and they are starting to introduce computer science courses. We are seeing these introduced throughout the country. A new computer science AP exam was recently introduced just two years ago, which has really increased the number of women and minorities taking computer science and enrolling in computer science and succeeding at that exam.

At the elementary levels, we are doing intense professional development with teachers to make sure that they know how to incorporate technology in the best ways into their classrooms. Often times teachers will show up into classrooms and they have, you know, a stack of ThinkPads and a smart board and we have to make sure that they are getting the professional development and the support to integrate those tools into their teaching. We know they can, but they just need a little support doing that.

Mrs. ROBY. So, I am just going to interrupt you for a second because it made me think, how do you guys identify underserved

communities so that you can make sure that these resources are getting into communities that haven't had access?

Dr. MARRONGELLE. Right. Great question.

There are several ways and one is through the EPSCoR program at NSF, and EPSCoR is government-wide, so that certainly locates states where we have additional need. But then in our calls for grant proposals, there are different ways that grant proposers can identify how they are defining underserved, whether it is geographically or rural or urban, whether it is low-income, whether it is groups who, historically, have not had opportunities in STEM. There are a variety of ways that our proposers can identify the ways in which they see underrepresented needs in their communities because it is local.

Mr. KINCAID. Now, I would add to that how we reach students depends on the audience and what age they are. When I think about your first question, I also have 3 kids and 2 are college-aged, but one is 11. How I would inspire 11-year-olds across the country is a little different than 18-year-olds.

I was thinking about a couple of thoughts. What you have in front of you is a little booklet that we created and it is about forward to the moon and going back to the moon and what that might look like with Artemis. Giving students a chance to have hands-on experiences that they can help better understand concepts is an opportunity that I think NASA and our Federal agencies have.

I also think about something that we have. We have something called NASA EXPRESS. It is a weekly email that goes out to about 40,000 educators across the country with information about content that teachers can use in the classroom to connect with them.

We talked briefly about rural. It is challenging to figure out ways to get information handed to them, and NASA, as a small agency, is not going to be able to send a person to every place, but we can send through digital sources, through STEMonstrations I briefly mentioned, through other resources and partnerships. I think there is a real opportunity here to make a difference.

Mrs. ROBY. Well, that is great. And we appreciate the work that you are doing and thank you, again, for being here today.

And any additional information that you want to send our way—I know we put out a weekly newsletter—not weekly—maybe twice a month about grant opportunities, so our constituents are aware of what monies are available. Obviously, we don't write the grants, but we do want to make sure that folks that are looking for these opportunities and want to pursue them know that they are there. So, I just want to make sure that we are in contact with you so that we have the most up-to-date information about how these different monies can be utilized, particularly, in my district.

So, I look forward to continuing to work with you and thank you, again.

Mr. SERRANO. Thank you, Mrs. Roby, and thank you for adhering to the 5-minute rule.

Mrs. ROBY. I didn't know that I did, but great. [Laughter.]

Mr. SERRANO. I am trying to send a message here—I am trying to get you to send the message.

Ms. Meng.

Ms. MENG. Message received. [Laughter.]

Ms. MENG. I want to piggyback off of Mrs. Roby's comments and questions. And it is no surprise that we have a similar line of questioning, as a fellow colleague and a wonderful mom, I wanted to also add that I have a 9-year-old and an 11-year-old and also a niece who is now fascinated with STEM subjects and a large part of that is due to her science teacher in elementary school. And I wanted to, I guess, get—and you don't have to answer this today—but I wanted to get a better sense of some of these programs that you are talking about and maybe what the footprint is in New York state, selfishly, my district, but would be more interested in finding out about those opportunities and how we can work even more closely together.

But also as you talk about the diverse and amazing talent pool of students in the U.S., but diversity is not always reflected, as you know, in business, academia, and even government. And so, I wanted to know what can Congress do to better support your efforts legislatively, as well, to help improve that diversity and increase opportunities.

And also, what can our business community do to be better partners. They say they are concerned about it, but I am just curious what you think.

Dr. MARRONGELLE. Thank you. Those are great questions and we will certainly get back to you with specific information about New York, where there are many exciting projects happening.

This year we partnered with the Boeing company on two separate projects. They gave us \$11 million to partner with them. A million of it went to our NSF INCLUDES program and it was focused on bringing women back into the STEM workforce who have had a gap in the STEM workforce with a particular focus on veteran women. We were able to award some projects that are figuring out ways that we can reach those women and get them back into, at the post-secondary level, back into programs where they can get credential and degrees in the STEM disciplines. It was very exciting and it was wonderful to see Boeing step up in that way.

The other way that we are working with Boeing with ten million of that \$11 million was on re-skilling their current workforce and they are interested in figuring out, really being part of the solution for the nation, how do we ensure that the workers of today are going to have the skills for tomorrow, and how do we do this using the technological tools that we have available to us with online platforms, the data that are generated from those platforms, and ways to fit education into the spaces of people's lives, which particularly affects women who have encountered challenges in that respect.

If we have more companies like Boeing stepping up and working with all of our agencies, that is one example of a way that we can really make forward progress.

Mr. KINCAID. It really is a great question and you really touched on a number of different ways that NASA can reach people, whether that is through our partnerships with our companies that we work with or whether that is the partnerships that Space Grant is required to build. When they build their affiliate network, they bring in partnerships and a wide range of companies.

I also point out to you another partnership that we had. As part of the 50th-anniversary activities we brought together industry, different agencies together to look at how could we use the fiftieth anniversary to engage kids. It is really cool, we had a chance to—if you have ever taken your kids to the National Park Service—my daughter likes to become a junior ranger when you go to one of those locations—we actually partner with them on Spaceflight Explorer. The National Park Service, we provide the content; they distributed 50,000 of these across the national parks this last year for students to become junior rangers in spaceflight exploration.

Again, I think we have to go through non-traditional ways to find mechanics for students to connect with STEM that we may not normally think of.

Ms. MENG. Thank you. And a second, quick follow-up question on a related topic, but more in terms of higher education, minority-serving institutions. These institutions tend to have relatively low educational and general expenditures, but enroll high proportions of financially needy students. A lot of these schools have challenges that affect their ability to obtain financial support and might affect their ability to compete for the larger multi-year, multimillion-dollar Federal grants and contracts to support STEM education.

I wanted to ask what NASA and NSF might be doing to help these institutions that might lack that ability to effectively compete.

Mr. KINCAID. Again, that is a really great question. About a third of NASA's budget goes to what we call MUREP, Minority University Research and Education Programs, and so, that is money set aside to work with minorities and institutions to do exactly what you talked about, build capacity for them to compete for other awards. We reached them in a number of ways, through direct reach, because we have contacts with minority HBCUs and MSIs across the country. We also work with our Space Grant network; again, they are a logical partner to work with.

The third thing I mentioned is something we call “technology infusion roadshows.” A couple of times a year we will go to a different part of the country and we will provide information from our Space Technology Mission Directorate, as well as our office of small business to go out and talk to minority-serving institutions to help them be better prepared. We have been in New Mexico and Atlanta this year and we will be in Puerto Rico in November. It is a concrete way that we can show up and help universities navigate their way through that process.

Dr. MARRONGELLE. The NSF is deeply committed to this work; in fact, this week, I have several program officers who are at Claflin University in South Carolina doing outreach to HBCUs and other MSIs in that region, specifically focused on working with universities who have not been successful or have not even applied for NSF funds through the education and human resources directorate.

We do this type of outreach regularly, and we do it geographically spread. We have a staff associate who has done an incredible amount of work in the Pacific Islands that has led to successful grant applications from universities in Guam and to the Mariana and Samoa, Marshall, and Carolina Islands.

We take seriously the notions of in-reach, as well, so ensuring that the staff within the NSF building are also educated and updated on the challenges facing MSIs and other institutions who have not historically had success at NSF.

Finally, we partnered with the National Academies two years ago to study STEM at MSIs, and I think just as you described, one of the findings was the research support at MSIs is not at the same levels as other institutions, which really calls into question how competitive they can be. We have been taking the findings of that report very seriously, as we think about planning our outreach.

Mr. SERRANO. Thank you. And if I can interject here, you don't know how refreshing it is to hear the territories mentioned.

I will be leaving this place next year after 30 years in Congress and 46 in public office, and if I accomplished something, it could be that I instilled in folks that territories are not states, but they are American citizens and should be included in everything. But I don't think I could have accomplished that if we didn't have people like yourselves who understood it before I brought it up. And that is important, so it is nice to hear.

And it doesn't make me feel bad as chairman of this committee to have a year and a couple months to keep saying it. Thank you.

Ms. Kaptur, you have one minute. [Laughter.]

Mr. SERRANO. You see, here's my plan. If I give you a minute and you stretch it to 5, we will make the time limit.

Ms. KAPTUR. Well, Mr. Chairman, I know you to be a very fair person. [Laughter.]

Let me just say it is an honor to be here with you—

Mr. SERRANO. Thank you.

Ms. KAPTUR [continuing]. Especially this morning, and, of course, all of our colleagues.

I wanted to begin with a brief statement that I would be remiss if I did not register my strong objection to the administration's budget proposal to eliminate the STEM programs at NASA in its fiscal year 2020 budget, and I also wanted to lodge my objections to the proposed offset for the Artemis program budget and the proposal to repurpose funding from the Pell Grant program to fund an accelerated moon landing.

For me, this is a nonstarter, and I don't think we should cannibalize one education program for another purpose. So, I just wanted to begin with that.

My questions really involve STEM, directly. We thank you for your life dedication to learning for the future generations. And I just wanted to begin with a suggestion and a question that relates to American ingenuity in space.

I represent a company called Cedar Fair and among its facilities across the country, over 26 million people walk through their gates every year. In my district, we have something called Cedar Point, the largest roller coaster in America. It is a marvel of physics when you look at it and engineering, and just at that site, 3.6 million visitors come every year, largely, youth who have the guts to get on some of those rides.

And I understand there is a precedent to writing STEM partnership agreements with theme parks. Can you elaborate on what steps you might take to make a partnership agreement with this

company if they would be willing. I haven't asked them, but I just think there is enormous opportunity to influence the thinking of young people and teachers and others who pass through those gates. So, that is question one.

Questions two has to do with districts like mine and, frankly, the chairman's—Chairman Serrano's district. If you were to look at the distribution of the members of Congress here and the mean incomes of the districts from which they come, out of 435 members, my district ranks 407 in the country in terms of mean income of its citizenry. Congressman Serrano's district—Chairman Serrano's district ranks 435. And so, the district number one is Congresswoman Eshoo, who comes from the tech belt in Northern California.

So, if one looks at what's happening to our economy and the distribution of assets in this society, it is very unequal, and my question is, what steps might you take to make your outreach more sensitive to the economic variations across districts in the country and what might you do working with our Department of Energy labs, all of which need Americans to apply for positions within them, where people will be retiring, particularly in the areas of nuclear thermal propulsion, battery storage, resource utilization? There are a lot of areas—cyber—where we need people that we don't have right now as we transition to generations taking over these positions.

So, the first one has to do with, can you work more effectively with theme parks to advance STEM and, secondly, in terms of your work across the government of the United States, could you somehow add more sensitivity to mean incomes of districts in linking with DOE to assess what might exist within them so we get a fair distribution of STEM recruitment across the country.

Mr. KINCAID. Thank you, Congresswoman.

You know, NASA is also looking for nontraditional ways that we can reach students through partnerships and, yes, we have worked with other theme parks to take NASA content to implement that. We have worked with Hollywood studios. We have worked with different entities to figure out how do we get role models and interest in STEM and lots of different sources. We would be happy to work with you. I visited with you and your staff yesterday. I would be happy to spend more time talking with Cedar Fair about that, I would be interested to hear more.

I would also point out to you that there is something called the NASA Museum Alliance. It says museum, but it really gets at all of our informal education institutions. So, it could be visitor centers. It could be science centers, libraries, different entities. Over 1,000 members are part of that, and what we want to do is provide them with information that they can use for the constituents in their area.

You and I talked yesterday about some of the issues with the Great Lakes and the science issues that can be applied there. NASA's Earth Science Missions have content that I think would be useful and perhaps different than maybe would apply to a group of students in Arizona. Being able to work with folks in your district through the Museum Alliance would be a great opportunity.

The other part of your question went to the Department of Energy. I would just point out that the Department of Energy is part of our FC-STEM. When we meet monthly, as Karen and I were briefly talking before about how FC-STEM brings together different Federal agencies to look at things we can do. One of our interagency working groups is collaborations and partnerships, and I think I can speak for Karen, we would be happy to visit with our colleagues over at the Department of Energy to see if there is a way that we can continue to work together. And I know that NSF already has some work in that area.

Ms. KAPTUR. Do you provide scholarships for those young people in any way?

Mr. KINCAID. We don't provide scholarships directly. We tend to provide internships. We want to give them real-work experience and we—

Ms. KAPTUR. Are those paid internships?

Mr. KINCAID. Those are paid internships. This last year—in fact, thanks for asking me—we hosted over 8,000 students and fellows that received over \$32 million in salary for those times and 40 percent of them were women and 30 percent were ethnic or underserved populations. Your point is a good one about needing to reach all of America. Thank you.

Dr. MARRONGELLE. Thank you for your questions.

With regard to theme parks, we have a very robust program that focuses on informal science education, and we partner with museums, with television programs, we help produce large-screen films, and theme parks would certainly fit within the realm of our informal science-education program. As you pointed out, there is so much physics to be learned at an amusement park and we know that teachers have taken advantage of that, but that is certainly something that would fit very well within our informal learning program.

Those programs reach millions of people. They really have impact. The Magic School Bus, in fact, was just highlighted yesterday on 1-A on NPR. NSF was an early supporter of The Magic School Bus and folks called into the program to talk about the impact that the show had on their career choices and their decisions to pursue science.

With regard to outreach, so your point is very well taken and the data show that there are differences in academic achievement in the STEM disciplines based on income differences from families. So, we know that this is a problem.

As I discussed earlier, NSF takes this very seriously and we have been purposeful in our outreach and focusing on communities that have not had access to NSF, have not had success at NSF and we will continue to do that.

We have a couple of programs that specifically focus on low-income, high-achieving students and S-STEM is one of those programs, Scholarships for STEM. This is a program funded by H-1B visa funds and, in fact, there is a new grant to the University of Toledo just this year that is focusing on getting kids into engineering and engineering technology programs and it supports them with scholarship funds and brings them in as a cohort and provides the supports that those students need to be successful.

There are S-STEM programs all across the nation. In fact, I was just at a PI meeting last week. There were over 600 people at that PI meeting. S-STEM really has had a huge impact on reaching kids who may not have the money to pursue their higher education and it is providing not only the dollars in their hands, but the curricular innovations that they need to be successful.

Finally, in regard to national labs, we have several types of partnerships with national labs, but one unique one is our Louis Stokes Alliance for Minority Participation in science works with the Brookhaven National Lab and provides community college students internships at Brookhaven. That is just one example of the types of partnerships through our programs that we can provide to students in conjunction with the labs.

Ms. KAPTUR. Thank you, Doctor.

I hear the gavel, Mr. Chairman.

Thank you, Mr. Kincaid.

Mr. SERRANO. Doctor, this committee has been able to robustly fund a new Hispanic-serving institutions program over the past few years. Are we seeing any results from this yet? And a follow-up would be what initial indicators should we be looking for to see if this new program is working well?

Dr. MARRONGELLE. Thank you for the question.

This is such an exciting program to get to know at NSF. As you point out, this is only just a couple years in, so we don't have results yet. We are having a PI meeting later this fall and we hope to see some preliminary results.

What I really enjoyed about the way—the approach that NSF took to this program is that it was developed with direct input from Hispanic-serving institutions, so faculty, students, administrators, community members had an opportunity to meet with NSF staff through conferences and listening sessions and had direct input into what are those specific needs. There were three needs that were raised during those sessions.

The first is critical transitions, so looking at transitions from students in community colleges to four-years, high school to college. The second was the need to promote innovative cross-sector partnerships. And the third was to better understand the teaching and learning of STEM in Hispanic-serving institutions.

As a result of that direct input, our call for proposals was crafted around those priority areas and we have many exciting projects. We have over 60 projects now funded through this program that are addressing those critical-need areas identified by the HSIs, themselves.

Mr. SERRANO. And how many schools did you say we had?

Dr. MARRONGELLE. We have around 60 projects. We can get you the exact number.

Mr. SERRANO. Sixty?

Dr. MARRONGELLE. Yeah, six zero.

Mr. SERRANO. I would like to see that. That would be good.

[The informations follows:]

APPENDIX C

INFORMATION ON HSI PROGRAM AWARDED PROJECTS FY 2018

The Improving Undergraduate STEM Education: Hispanic-Serving Institutions (HSI) Program aims to enhance undergraduate STEM education and build capacity at HSIs. Projects supported by the HSI program will also generate new knowledge on how to achieve these aims. Complete project abstracts can be found at: <https://www.nsf.gov/awardsearch>.

RESOURCE HUB

1832338, 1832345: *NSF National Resource Hub for STEM Education at Hispanic-Serving Institutions*

This collaborative project at New Mexico State University, Dona Ana Community College and California State University, Northridge, will advance the aims of the HSI Program by establishing the NSF National Resource Hub for STEM Education at Hispanic-Serving Institutions. (PI Elba Serrano, New Mexico State University; PI Mariaelena Zavala, The University Corporation, Northridge)

TRACK 1: BUILDING CAPACITY

1832237: *The Dominican University STEM Success Model to Support Students through Critical Transitions*

This project will advance the goals of the HSI Program by implementing teaching and student support practices that can increase the success of undergraduates in early STEM courses. (PI Christopher Anderson, Dominican University)

1832282: *Institute for Interdisciplinary Science: Preparing Students for the 4th Industrial Revolution*

This project aims to create the Institute for Interdisciplinary Science. (PI Andrea Holgado, Saint Edward's University)

1832335: *STEM Faculty Professional Learning in the Zone of Proximal Development*

This project, a collaboration between California State University, Sacramento, and the University of California, Irvine, will support efforts to improve the teaching effectiveness of STEM faculty and to advance knowledge about strategies that lead to increased use of evidence-based and equity-minded teaching strategies. (PI Lynn Tashiro, University Enterprises, Incorporated)

1832348: *An Intervention to Improve Success of Biology Majors in Mathematics*

This project at Los Angeles Mission College will advance the aims of the HSI Program by developing a student-centered intervention to support the success of undergraduate biology students. (PI Parvaneh Mohammadian, Los Angeles Mission College)

1832357: Guiding Critical Transitions to the Baccalaureate

This project at Riverside City College will advance the aims of the HSI Program by developing and analyzing the impact of six interventions for Riverside College Promise Program students who have declared STEM majors. The interventions include a summer bridge program from high school to college, home courses, college and career workshops, research experiences, near-peer mentoring and cross-enrollment courses. (PI Virginia White, Riverside Community College District/Riverside City College)

1832388: Transforming STEM Undergraduate Education through Academic Literacy, Mentoring, and Professional Development

This project at the University of Texas at San Antonio will advance the aims of the HSI Program by developing new curricula and methods of instruction that increase student persistence and success. (PI Heather Shipley, University of Texas at San Antonio)

1832405: Polytechnic for All: STEM Undergraduate Success via an Inclusive Institution

This project at California State Polytechnic University, Pomona, will advance the aims of the HSI Program by developing and implementing a multifaceted approach to enhance student learning and success in STEM. (PI Paul Beardsley, Cal Poly Pomona Foundation, Inc.)

1832421: Addressing Critical Transitions of First-Year STEM Students

This project at Northeastern Illinois University, an HSI, aims to increase retention of students by engaging them in a supportive, research-based learning community called Agua en Comunidades Experimentales (ACE), which means Water in Research Communities. The ACE learning community will include social support, scientific training and research experiences related to water science. (PI Laura Sanders, Northeastern Illinois University)

1832425: Infusing Research as Pedagogy

This project at Union County College will advance the aims of the HSI Program by integrating research into undergraduate STEM courses. The project plans to embed course-based undergraduate research experiences (CUREs) into STEM gateway courses, support independent research experiences during the academic year and develop a summer research academy. (PI Liesl Jones, Union County College)

1832436: STEM Student Success from Two-year to Four-year Institutions through Classroom-Based Undergraduate Research Experiences

This project will advance the aims of the HSI Program by adding course-based undergraduate research experiences (CUREs) to introductory algebra, biology and chemistry courses, which serve as gateways into STEM majors. The project is a collaboration between Miami Dade College, the largest two-year HSI in the nation; the University of Florida; and the University of Miami. (PI Pablo Sacasa, Miami Dade College)

1832446: Engaging Stem Transformative Experiences for Early Momentum

This project at Hartnell College will advance the aims of the HSI Program by creating transformative early experiences in STEM research that will help equip students to overcome obstacles to success in STEM programs. (PI Mohammed Yandi, Hartnell College)

1832450: Catalyzing Change in Calculus

This project at Florida International University will advance the aims of the HSI Program by increasing the success of students in calculus. Leveraging a partnership with Broward College, the project will implement Modeling Practices in Calculus, a student-centered curriculum in which students learn calculus by engaging in the authentic practices of mathematicians. (PI Laird Kramer, Florida International University)

1832457: *Enhancing Undergraduate STEM Education by Enhancing Transfer Success*

This project will advance the aims of the HSI Program by increasing the number of students from community colleges who transfer to four-year STEM programs and by accelerating their baccalaureate degree completion. The partners include the Borough of Manhattan Community College, Bronx Community College, Guttman Community College, Hostos Community College, Kingsborough Community College and LaGuardia Community College. (PI Pamela Brown, CUNY New York City College of Technology)

1832464: *STEM Transformative Experiences Project*

This project at Saint Peter's University will advance the aims of the HSI Program by providing 45 high-impact, off-campus internship experiences each year to low-income undergraduate students who are pursuing STEM degrees. (PI Jeanette Wilmanski, St Peter's University)

1832468, 1832427: *A Collaborative Undergraduate STEM Program in Resilient and Sustainable Infrastructure*

This project will advance the aims of the HSI Program by increasing the number of students who complete baccalaureate degrees in engineering or related degrees in resilient and sustainable infrastructure. This collaborative project between the University of Puerto Rico (UPR) Mayaguez, UPR Rio Piedras and UPR Ponce will develop an interdisciplinary Resilient Infrastructure and Sustainability Program to educate undergraduate STEM students in engineering and related skills needed to respond to natural disasters. (PI Carla Lopez del Puerto, University of Puerto Rico Mayaguez; PI Humberto Cavallin, University of Puerto Rico-Rio Piedras)

1832472: *Building Capacity of Women in STEM*

This project at Mount Saint Mary's University will advance the aims of the HSI Program by increasing retention in STEM and preparing students for research and other opportunities in STEM. (PI Jennifer Chotiner, Mount Saint Mary's University)

1832507: *A Faculty Development Program to Increase Students' Quantitative Reasoning Skills*

This project will advance the aims of the HSI Program by improving the ability of STEM faculty to teach quantitative reasoning skills to undergraduates. The project is a collaboration between three colleges in the City College of New York (CUNY) system: Lehman College, Baruch College and LaGuardia Community College. (PI Esther Wilder, CUNY Herbert H. Lehman College)

1832511: *Positive Learning Opportunities and Research Experiences to Promote Success in STEM*

This project at Saint Xavier University will advance the aims of the HSI Program by increasing retention and graduation rates of undergraduates in STEM fields. To this end, the project will create a STEM Studio that will provide students with ongoing community, social and academic supports. (PI Bindhu Alappat, Saint Xavier University)

1832523: *Transforming Undergraduate Education in STEM Through Culturally Relevant Pedagogy and Community Engagement*

This project at the University of Texas Rio Grande Valley will advance the aims of the HSI Program by increasing the retention and graduation of undergraduate students in science and mathematics. The project plans to achieve its goals by offering well-designed, high impact STEM courses that build upon culture, community engagement and regionally relevant research. (PI Alexis Racelis, The University of Texas Rio Grande Valley)

1832528: *Undergraduate STEM Transitions, Experiences, and Mobility*

This project at San Diego State University will advance the aims of the HSI Program by transforming the pathways taken by STEM undergraduate students. Specifically, the project will identify mechanisms of support for students' transitions between two- and four-year colleges, in addition to the multiple movements that might occur prior to this critical transition. (PI Felisha Herrera Villarreal, San Diego State University Foundation)

1832534: *Integrated Interventions to Improve Undergraduate Student Success in STEM*

This project at the University of Houston will advance the aims of the HSI Program by improving retention of students from first-year courses to higher level courses, and through completion of their bachelor's degree. The project will analyze student motivation and desire for obtaining a STEM degree. It will also implement and test the effectiveness of academic interventions, such as a summer bridge program, on student success. (PI Donna Stokes, University of Houston)

1832536: *Advancing Student Success in Undergraduate Engineering and Computer Science*

This project at California State University-Fullerton will advance the aims of the HSI Program by increasing retention and graduation rates in computer science and engineering, and reducing high repetition rates in lower-division STEM courses. The project seeks to generate new knowledge about the role of social support mechanisms in helping students overcome these challenges. (PI Sudarshan Kurwadkar, California State University-Fullerton Foundation)

1832538: *Improving the Undergraduate Chemistry Experience by Green Chemistry, Active-learning, and Peer-led Experiences*

This project at the University of California, Merced, will advance the aims of the HSI Program by increasing undergraduate student interest and success in chemistry. The project will redesign laboratory courses to use student-guided inquiry and green chemistry; develop a peer-learning environment that builds a sense of community; and develop short videos to complement lower-division chemistry courses. (PI Erik Menke, University of California, Merced)

1832543: *Integrating Research, Mentoring, and Industry Collaborations to Improve STEM Recruitment and Retention*

This project at Phoenix College will advance the aims of the HSI Program by incorporating multidisciplinary Course-Based Undergraduate Research Experiences (CUREs) into STEM curricula in colleges throughout the district. (PI Robin Cotter, Maricopa County Community College District)

1832553: *Building Bridges into Engineering and Computer Science*

This project at Wilbur Wright College will advance the aims of the HSI Program by enabling talented, underprepared, low-income students to pursue and complete a bachelor's degree in engineering or computer science. The project aims to develop and implement pathways, practices and interventions to support student success in engineering or computer science at two critical transitions: from high school to community college and from community college to four-year universities. (PI Doris Espiritu, City Colleges of Chicago Wilbur Wright College)

1832558: *Collaboration for Inclusive and Engaging Curriculum, Instruction, and Achievement*

This project at the California State University-Stanislaus (Stanislaus State) will advance the aims of the HSI Program by improving STEM student retention, graduation and success by developing a STEM faculty culture of evidence-based teaching and student-centered learning environments. (PI Matthew Cover, California State University-Stanislaus)

1832567: *City College of New York STEM Communities*

This project at the City University of New York (CUNY) City College will advance the aims of the HSI Program by building a social media platform designed specifically for students entering, continuing or transferring into STEM majors. The platform will be designed as a "one-stop" location for academic support, tutoring and social interaction. (PI Joseph Barba, CUNY City College)

TRACK 2: HSIs NEW TO NSF**1832243: *Los Futuros de STEM (STEMFutures): Building Student Success in STEM***

The project will create a STEM professional development program, enhance student support and develop co-requisite supplemental instruction. (PI Jeffrey Alexander, Pueblo Community College)

1832545: *Using Ocean Plastic Research to Increase Student Engagement and Persistence in Biology*

This project at National University will advance the aims of the HSI Program by adding research experiences to undergraduate biology courses. Through a collaboration with the Scripps Institution of Oceanography, the project will incorporate course-based undergraduate research (CURE) biology courses for biology majors and for non-majors. The research topics will focus on plastic pollution in the ocean. (PI Ana Barral, National University)

1832433: *Recruiting and Retaining Students into Computing*

This project at Texas A&M University-San Antonio will advance the aims of the HSI Program by increasing the retention and completion rates of students in computer science and to better equip them to achieve careers in cybersecurity. The project also plans to increase the number of transfer students who transfer from two-year colleges into computer science programs at the university. The project plans to integrate cybersecurity topics throughout the entire computer science curriculum, so that students will obtain an NSA Cyber Defense Education certificate upon graduation. (PI Jeong Yang, Texas A&M University-San Antonio)

Conference Awards (4) from July 6, 2017 DCL deadline

1748199: *HSI Conference: Hispanic-focused STEM Ideas for Inspiration and Innovation*, Nova Southeastern University, FL; PI Meline Kevorkian

1748533: *HSI Conference: Understanding and Improving Readiness and Student Transitions*, University of Houston, TX; PI Andrew Hamilton

1748526: *HSI Conference: Transforming STEM Education in Hispanic Serving Institutions - Regional Insights from the Southwest*, University of Arizona, AZ; PI Guadalupe Lozano

1748570: *HSI Conference: Pathways for Hispanic Students in STEM*, University of California-Irvine, CA; PI Michael Dennin

Conference Awards (7) from Sept. 20, 2017, DCL deadline

1800200: *HSI Conference: URBANO-Increasing Access and Success in Urban STEM Programs*, CUNY City College, NY; PI Jorge Gonzalez.

1764378, 1764166, and 1764249: *Collaborative HSI Conference: Co-Designing an Engineering Education Research Agenda*, University of Texas-El Paso, TX; PIs Meagan Kendall, Alexandra Strong and Ines Basalo.

1802552: *HSI Conference: Accelerating the Impact of HSI STEM Education and Research on Innovation Ecosystems*, University of Puerto, PR; PI Rodolfo Romanach.

1759566: *HSI Conference: Catalyzing Progress in Undergraduate STEM Education with Insights from Midwestern HSIs*, Northeastern Illinois University, IL; PI Laura Sanders.

1764268: *HSI Conference: Stakeholder Perspectives on Challenges and Opportunities for Improving Undergraduate STEM Education at HSIs*, Texas A&M Engineering Experiment Station, TX; PI William Kitch.

1764323: *HSI Conference: Dissecting the STEM Education Ecosystem in Hispanic Serving Institutions (HSIs): Regional Insights from Southern California*, California State University Fullerton Foundation, CA; PI Yusheng (Chris) Liu.

1759134: *HSI Conference: PROMISE: Providing Resources and Opportunities for Minorities in STEM Education*, Laredo Community College, TX; PI Nora Garza.

Mr. Kincaid, a 2016 film entitled—details the struggles of three African-American women in Hampton, Virginia, who were mathematicians and engineers, critical to the Apollo missions. The unit was segregated by race and sex and suffered from the discrimination that accompanied such segregation.

Additionally, a former colleague of ours, Congresswoman Louise Slaughter, may she rest in peace, was a microbiologist and often told the story that her first job after receiving her master's degree was to sell soap for Proctor & Gamble, rather than practice her skill.

Could you describe efforts within the NASA STEM program to address opportunities for women and minorities.

Mr. KINCAID. Absolutely. Thanks again, Chairman, for the question.

You know, that movie was a powerful one and it was fun for me to take my 11-year-old daughter—she was 8, I guess, at the time—to go see the role NASA played. While it was a difficult time in our country, I think NASA played an important role for those engineers to really make a contribution to NASA's space program. I think that is true today.

I think NASA continues to be able to provide role models, whether that is astronauts in space on the space station or whether it is—our Administrator likes to say—the first woman to step foot on the surface of the moon. I think these are powerful images that can really truly shape the way that kids see themselves growing up.

I think we provide a number of resource opportunities. I briefly mentioned that of the 8,000 interns this last year, 40 percent were women and 30 percent came from an underserved background. I think NASA continued to make a difference there.

When I think about some of the programs that we have with MUREP, Minority University Research and Education Programs, we recently awarded 8 institutions as part of our MIRO award. It's the Minority Institution Research Opportunity. How do we make sure that we can help minority-serving institutions across the country have access to NASA's work. One of those was in Puerto Rico.

So, it is a great opportunity, I think, to be able to connect people throughout the country, not just at NASA's centers, but with work that NASA does.

Mr. SERRANO. And as everyone knows, I have an interest in what's happening at the territories. Are there any unique challenges to reaching STEM students in the territories and what programs have been shown to be most effective in reaching these populations?

And, you know, when we say "reaching the territories," some people may think that is an improper question, but—you don't have to comment on this—we had a situation where people were told that the reason Puerto Rico could not be helped right away was because it was an island surrounded by water in the middle of the ocean, and I sarcastically or profoundly suggested it is the same way it was invaded by the military in 1898, we could probably find a way to get there during a hurricane, but we are still waiting for their response.

But, what about reaching to the territories?

Mr. KINCAID. I think it is an important question, and we highlighted a couple of things already that I could probably draw your attention to. One is one of our Space Grant consortiums is in Puerto Rico and making sure that we can help them. I would also say that our new solicitation is further strengthening the role that we play for the Virgin Islands and Guam by partnering them with Hawaii and South Carolina, respectively. Being able to provide that information to students in those areas is important.

The technology roadshow that I briefly talked about where we go out on the road, the next one happens to be in Puerto Rico. I think there is an opportunity for us to take our content and go wherever that might be, whether that is in Puerto Rico or Wyoming, wherever that might be. We need to be at places that may not otherwise find NASA content. Thanks for the question.

Dr. MARRONGELLE. Similarly, for NSF, I described some of the outreach that we have done with the Pacific Islands. Puerto Rico was a host site of a listening session in the development of the HSI program and provided invaluable input. We have INCLUDES awards that involve Puerto Rico. The Virgin Islands was just the recipient of a new Alliance award from NSF INCLUDES this year.

We take very seriously the outreach to the territories in ensuring that people there have access to NSF, that they understand that NSF is approachable and supportive of the work that goes on and we are constantly looking to update our outreach activities.

Mr. SERRANO. Well, we appreciate and we hope you continue to focus on that and focus on all the states and territories.

And with that, we recognize the legendary Mr. Aderholt.

Mr. ADERHOLT. Yes. Thank you, Mr. Chairman.

I would just follow up on what we talked about FC-STEM a little earlier. I just wanted to follow up with a question. Are you looking into any public-private partnerships and how you can leverage STEM funding initiatives from that respect?

Mr. KINCAID. I would say one of the five Interagency Working Groups is looking at strategic partnerships and why I think our efforts initially we are looking at how do we get the current Federal agencies to work together, you know, that is the first challenge is to get us all talking, I think we want to make sure that those partnerships are more than—so, I guess we get ourselves as organized as we can—external organizations is a really critical part of what will come—

Dr. MARRONGELLE. Yes—thank you. I mentioned the Boeing example. That has yielded such great collaboration with the thinkers at Boeing and that is something that we of course would be looking for ways to bring that type of partnership to FC-STEM.

Mr. ADERHOLT. Ms. Marrongelle, let me address this question to you. According to the National Science Board's science and engineering—for 2018, last year STEM's bachelor degree awards totaled more than \$7.5 million globally. Half of those degrees were conferred in India and China, 20 percent were conferred in the European Union countries and only 10 percent in the United States.

Just your thoughts, your concerns that you might have about the (indiscernible) conferred in the United States, compared to other countries that could, of course, obviously impact our competitiveness and especially China.

Dr. MARRONGELLE. Thank you for the question. This is something that I think about every day, of course. We would like to see more students attain STEM degrees. We know where some of the gaps happen. We know that in some of the STEM disciplines, but not all, students will enter college wanting to major in STEM and then decide to switch their major. Mathematics probably has the highest number of students switching out of mathematics as a degree when and if they switch degrees in college.

We are taking a look at why this is happening, and this is not a new problem; this has been going on for decades. I think some of the projects that we have been funding are taking a look nationally at what's happening in classrooms and college campuses, what is the type of instruction that students are experiencing and when is it positively impacting them and contributing to their retention and a degree, and when is it setting them off course and having them decide not to pursue a STEM degree.

As we have access to larger datasets from online courses, from more sophisticated data collection, we are able to interrogate these problems at a level that we haven't been able to in the past. And so, I am very hopeful that we are going to make even greater progress and greater strides in understanding how we keep students in the STEM disciplines once they decide to be there.

Just like the award at the University of Pittsburgh that I mentioned earlier, we are ensuring that when students show an interest in STEM early on, those pathways are open to them and they don't have doors closed as they attempt to go attain STEM degrees.

Mr. ADERHOLT. Do you have any thoughts on that? Well, Mr. Kincaid, let me switch to you just a second regarding the Space Grants and the changes. Recently, of course, NASA proposed changes to the Space Grant program for fiscal year 2020 through 2024 and the changes include removing the distinction between designated and non-designated states and reducing annual funding to support mission directorate competitions.

My question to you would be, given that—of course I represent a designated Space Grant state, and it could lose funding with these proposed changes. Can you take just a second and explain what drove NASA to make the changes to this Space Grant program.

Mr. KINCAID. Thank you, sir.

Yes, when I started this job two and a half years ago I spent two full days spending time with the Space Grant directors from across the country. They get together once a year and they spend time. We were in North Dakota and I listened to the concerns they had and the strengths that they saw in the program and it was, frankly, a very insightful conversation.

When Congress directed us to create the Space Grant program in 1989, we initially selected 25 states. The next year, Congress appropriated more funds and they started this process where people would graduate the two tiers that you discussed.

As I dug into it, from the 17 states that did not receive the same amount of money—it is a couple-hundred-thousand-dollars difference between the two—they are very concerned that they hadn't had an opportunity to be able to compete for this higher amount.

So, I spent time visiting with them about that and at the last time we had a competition for the 17 states to make it into what you referred to as “designated,” and what we refer to as “designated” was 2004, so it had been 15 years.

I thought about considering a competition process, but, frankly, I think Space Grants, in general, have done a really good job over the years. The other thing that they told me is those states that had competed told me how onerous and burdensome the process was to go through the Federal Government of graduating. It made sense to me that we would fund them equally.

It is true that the 35 states are coming down a little bit in order to bring up the other 17 states.

Mr. ADERHOLT. Well, rather than simply removing all designations, did you consider reopening a competition to see which of the states that are currently non-designated were actually willing to go through that process and to become a designated state?

Mr. KINCAID. I did. Again, in talking to the states that had gone through that process to become designated, as I dug into it—again, it had been 15 years since we had gone through it—I really felt like most Space Grants would have succeeded and to put all 17 states through a process seemed onerous and I wanted to figure out a way to make it simpler.

At the end of the day if I was going to give awards to 51 out of 52, it made sense to go ahead and just provide everyone the same amount of money.

Mr. ADERHOLT. If Congress were to provide additional funding for Space Grant in 2020, fiscal year 2020, would that funding go to the states to be used for additional Mission Directorate competitions?

Mr. KINCAID. Yes, the money would definitely go to the states. The amount of money that we have kept at NASA to run the program has stayed relatively flat from '17, '18, '19, and I don't see any reason why that would change in the future. It is our goal to take the funds that we receive and send it out to Space Grants to be able to accomplish the things that we have talked about in today's hearing.

Thanks for the question.

Mr. ADERHOLT. Thank you, Mr. Chairman.

Mr. SERRANO. Thank you.

Mr. Cartwright.

Mr. CARTWRIGHT. Thank you, Mr. Chairman.

So the NSF's website states that the mission of the NSF is, quote, “to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense. NSF is vital because we support basic research and people to create knowledge that transforms the future. This type of support, number one, is a primary driver of the U.S. economy; number two, enhances the nation's security; and, number three, advances knowledge to sustain global leadership.”

And if I haven't already made myself clear, I want to make sure you both understand that I view this as a critically important part of our discussion today and it should be the starting point for how we view STEM education in this nation.

As a member of this subcommittee, I am proud to say we have always supported science and STEM education in a bipartisan manner, and I do want to thank our ranking member, Mr. Aderholt, for his participation and unwavering support.

Looking at the administration's fiscal year 2020 budget request, the NSF would have realized a 12 percent cut overall and a 10 percent cut to the Education and Human Resources Directorate, the NSF's flagship graduate research fellowship program would have been cut by 10 percent, and the Robert Noyce Teachers Scholarship would have been cut by 25 percent. The NASA budget would have seen a 5 percent increase, but the science budget would have been cut by nearly 9 percent, and the Office of STEM Engagement would have been entirely zeroed out.

Let the record reflect Mr. Kincaid reluctantly nodded in the affirmative.

It would have eliminated the Space Grant Program, which Mr. Aderholt was just discussing, the Established Program to Stimulate Competitive Research, and the Minority University Research and Education Project.

Mr. Kincaid, as the Associate Director of STEM Engagement, I assume this would have meant that you would have been out of a job, but the good news for you, NASA, NSF, and really this country is that this subcommittee rejected these cuts again on a bipartisan basis.

I know that in all likelihood neither of you think these cuts to STEM education are a good idea, while you are here to represent the administration and its budget requests for your respective agencies. I am not sure there is much to be gained by forcing you to defend what you undoubtedly understand is the indefensible.

Instead, I would like for each of you to take a message back to your respective agencies and to this administration: enough with these budget requests with Draconian cuts to science and STEM education. Members of this subcommittee may disagree on occasion about a wide range of subjects, the one thing we agree about again and again and again on a bipartisan manner is that we will not tolerate budget requests that have the effect of hurting science and STEM education in this country. It is simply not going to happen and you need to pass on to your bosses that they are wasting everybody's time with these proposed cuts.

So I have some questions. Do you believe it is important or even critical to our national security, economic development, and global leadership position in science and technology that we have a really strong recruitment and development program with respect to STEM education?

Dr. MARRONGELLE. Yes, sir.

Mr. CARTWRIGHT. Do you agree with the prevailing consensus that the U.S. is falling behind relative to global STEM education, both in terms of funding and participation?

Mr. KINCAID. I think we continue to face a challenge in that area, falling behind is the part that made me think—I think we have actually made some strides in that area, but I think it is continuing to be a challenge to—

Mr. CARTWRIGHT. I just looked at a recent USA Today article, it says China's top university now leads the world with the most cita-

tions in math and computer research, and is making similar gains with other highly cited STEM research. Did you catch that article?

Dr. MARRONGELLE. I have heard those statistics previously, yes.

Mr. CARTWRIGHT. Yeah. Do you believe that Federal STEM education programs have a positive impact on whether young students, particularly women and minorities, eventually go on to pursue advanced STEM degrees and careers in STEM?

Dr. MARRONGELLE. Yes.

Mr. CARTWRIGHT. Elaborate on that, if you would.

Dr. MARRONGELLE. Sure. I think through some of our evaluation and research we have shown the impact that our programs, both in formal school settings and in informal settings, have on motivating students, on showing them that there are pathways, providing ways of imagining opportunities in STEM for people who may not have even been imagining that. I think that for our programs that specifically focus on low income and groups of people who have not had access to opportunity, we are showing that those people can break the barriers and they can overcome the statistics that are not working in their favor.

Mr. KINCAID. I would add to that, when I think about FC-STEM looking across the Federal Government, to your question, I know my colleagues and other mission agencies like NOAA and NSF and other places want to use our content to be able to make a difference for kids; it is critical.

Mr. CARTWRIGHT. Well, in light of your answers, it is plain and obvious that we are all on the same page here. And we are not privy to what goes on behind the scenes at your agencies, but do us all on this subcommittee the favor of passing on the message that we are not cutting these programs, they are too valuable for our nation, and do your bit in pushing back on these cutbacks, will you?

I yield back.

Mr. SERRANO. Thank you.

Before we close, let me just take a moment to make a comment and just to reiterate what Mr. Cartwright has said. This committee is unique in many ways. It is my favorite subcommittee, not because I'm chairing it, but it was always my favorite subcommittee even when I was not chairing it, and past Republican chairmanships have seen the same way we see STEM education and the growth of education within what your agencies do.

At the expense of getting Mr. Aderholt in trouble with his colleagues, because, you know, our colleagues want us to be tough, you know, on behalf of the party, but he has been a pleasure to work with on these issues, because he also understands and supports. And these issues not only help Americans, but they also help certain regions of the country, certain states like Mr. Aderholt's state, which have NASA facilities and have—other states that have both of your involvements.

I think it is important to send the message back that we may not always be here and if you keep sending us—not you, but if you keep sending us budgets that hurt these agencies, you may actually get a group of people up here someday soon, who knows when, who would agree, and that would be devastating for our country. And

I mean for the country and the territories, you know, the whole country.

So, thank you for your testimony today. I hope it wasn't too difficult. We did not expect you to agree with us on how bad these cuts are, but we could tell by the twinkle in your eyes that you agree with us. And I just probably got you in real trouble.

Anyway, thank you so much and thank you for your service to our country.

Dr. MARRONGELLE. Thank you.

[Material submitted for inclusion in the record follows:]

The Honorable Robert Aderholt
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
Science, Technology, Engineering, and Mathematics (STEM) Engagement Hearing

Questions for NSF and NASA: Dr. Karen Marongelle and Mr. Michael Kincaid

STEM INVESTMENTS IN RURAL COMMUNITIES

Studies show that STEM education can provide workers with better employment opportunities that command wages above – and often double – the national average. And yet, millions of students in rural areas today face barriers to accessing high-quality STEM education. Such barriers include: teacher retention and shortages of mathematics and science teachers; inadequate resources; and limited access to broadband services.

1. In your opinion, what are the biggest barriers students in rural areas face in accessing high-quality STEM education?

Response: We concur on the major challenges you have cited.

Teacher recruitment, retention and preparation is important everywhere but there are special challenges in recruiting and retaining rural STEM teachers and helping them keep current. Technology can also be a challenge for rural students and teachers in accessing high-quality STEM education. Technology can provide incredible opportunities, especially for rural students and teachers, but depending on broadband access, technology may be a barrier.

2. What is your agency doing to provide more opportunities in STEM education for students in rural areas and to broaden participation in STEM programs nation-wide? And, how does your agency evaluate the effectiveness of these programs and initiatives?

Response: A recent look at EHR's portfolio revealed that EHR has 350 currently active awards involving rural STEM education across 21 different programs. Some of these awards focus directly on rural STEM education while others have that as one of several emphases. EHR programs provide support to the universities and colleges that serve rural communities and to investigators conducting STEM disciplinary or education research in or about rural areas. We also support outside-of-classroom opportunities for students to engage in STEM through libraries, community center, 4-H clubs, and others. Projects are tailored to specific settings and their resources and needs.

Proposals from or about rural, suburban, and urban parts of the Nation are welcome in all of NSF's programs. NSF's signature program for broadening participation, Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (NSF INCLUDES) is a comprehensive initiative to enhance U.S. leadership in science and engineering discovery by proactively seeking and effectively developing STEM talent from all sectors and groups in our society. By facilitating partnerships, communication and cooperation,

NSF aims to build on and scale up what works in broadening participation programs to reach underserved populations nationwide.

NSF's Robert Noyce Teacher Scholarship program addresses recruitment and preparation, while NSF's Computer Science for All program supports K-12 teachers with the tools they need to teach computer science and computational thinking. Our Innovative Technology Experiences for Students and Teachers (ITEST) program supports innovative models to engage preK-12 students in the technology-rich experiences that will excite them about STEM and STEM careers while also engaging their teachers. STEM learning opportunities in informal environments can contribute to STEM education for the entire community. Our program on Advancing Informal STEM Learning (AISL) supports these experiences and research on what is most effective.

The heart and soul of what we do at NSF is to aim to understand what is working for whom and under what conditions. We glean information from all of our projects to understand which ones are making a difference and if any of them are not, then what went wrong and what can be shared so that others do not repeat that practice.

FIVE-YEAR STRATEGIC STEM PLAN

Last December, the Administration released its five-year strategic plan for STEM education titled "Charting a Course for Success: America's Strategy for STEM Education." The plan calls for building strong foundations for STEM literacy, increasing diversity and inclusion in STEM, and preparing the STEM workforce for the future.

3. How does annual NSF and NASA funding help to carry out this five-year plan and assist you in your role on FC-STEM?

Response: The five-year strategic plan dovetails nicely with the STEM education programs at NSF; everything at NSF that we do fits into one of the three goals of the plan. The plan is a blueprint for our work, describing the work that we do. The five inter-agency working groups that are already set up are rolling out how the federal agencies are responding to the plan so that we draw on each other's strengths rather than overlapping with each other.

According to a 2018 CRS report, "annual federal appropriations for STEM education are typically in the range of \$2.8 billion to \$3.4 billion."

4. Given this significant federal investment, how is FC-STEM working to ensure that federal STEM efforts are not duplicated? And, that there is coordination among agencies on how federal dollars are being spent on STEM initiatives?

Response: The purpose of FC-STEM is to advise and assist the CoSTEM and the Director of the OSTP on developing strategic partnerships in STEM education across federal agencies. The FC-STEM serves as a forum for discussion and policy coordination to facilitate implementation of the 5-Year STEM Education Strategic Plan. FC-STEM members are leaders in STEM education at their agencies, and the group convenes regularly for strategic planning in support of Federal STEM education programs.

Once a week Dr. Marrongelle and Mr. Kincaid (Co-Chairs, Federal Coordination in STEM (FC-STEM) meet by telephone to discuss FC-STEM and how federal agencies can work together. Once a month they meet with FC-STEM. They report that the agencies are excited to come together and find opportunities for collaboration. The interagency working groups (IWGs) provide another opportunity for engagement and collaboration across federal agencies, sparking creative new ideas. Partnering with other agencies extends the reach of each.

Agencies are working together to maximize the impact of their efforts. For example, NSF is leading an interagency expansion of its Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (INCLUDES) program, one of the NSF Big Ideas that facilitates partnerships, communication and cooperation, to build on and scale up what works in broadening participation programs to reach underserved populations nationwide. ED, NASA, NIH, NOAA, NIST, and USGS are exploring how they can add their external stakeholder networks to the INCLUDES platform and leverage opportunities to use the INCLUDES program to better communicate their STEM education programs and funding resources to the public. A special Federal agency-only session at the INCLUDES National Network Convening in May 2019 helped to kick off the interagency expansion.

5. Is your agency looking into how public-private partnerships may leverage our federal STEM initiatives?

Response: In FY 2018, NSF established an Agency Priority Goal (APG) to expand public and private partnerships to enhance the impact of NSF’s investments and contribute to American economic competitiveness and security. By September 30, 2019, NSF’s number of partnerships and/or award actions with other federal agencies, private industry, and foundations/philanthropies to grow by five percent, relative to the FY 2017 baseline, to make available infrastructure, expertise, and financial resources to the U.S. scientific and engineering research and education enterprise. Although the reporting requirement for this APG has ended, efforts to expand public and private partnerships continue at NSF.

INTERNATIONAL COMPETITIVENESS

According to the National Science Board’s Science and Engineering Indicators report for 2018, last year, STEM bachelor’s degree awards totaled more than 7.5 million globally.

Half of these degrees were conferred in India (25%) and China (22%), 20% were conferred in the European Union, and then only 10% were conferred in the United States.

6. Are you concerned that the lagging number of degrees conferred in the U.S. compared to other countries could impact our economic competitiveness? Especially with countries like China?

Response: The 2018 Science and Engineering Indicators states that “The number of jobs in the United States (U.S.) requiring substantial science, technology, engineering, and mathematics (STEM) expertise has grown nearly 34% over the past decade. As of 2015, nearly one in seven workers with at least a four-year degree say that their job requires a “bachelor’s level” of STEM

expertise. Another 16 million skilled technical jobs—more than one in nine—do not require a bachelor’s degree, yet require significant expertise in at least one technical field.

At the same time, other countries are challenging U.S. leadership in science and technology. Between 2000 and 2014, the number of Americans with a four-year degree in S&E grew by 53% (483,764 to 741,763); in China, this number was 360% (359,478 to 1,653,565). China’s investments in higher education and research and development (R&D) have fueled the rapid growth of its high-technology industries. Their high-tech manufacturing output now ranks number two in the world, trailing only the U.S. China is not alone—other countries are increasing investments in R&D and education to compete with the U.S.

7. To create a more capable workforce, how is your agency using federal dollars to encourage students to pursue STEM degrees and remain working in these fields?

Response: NSF programs strongly support workforce development, which begins early. In their choices of subjects to pursue, young students make decisions that will affect them life-long and our research programs are exploring the reasons behind their choices. Our Innovative Technology Experiences for Students and Teachers (ITEST) program supports innovative models to engage preK-12 students in the technology-rich experiences that will excite them about STEM and STEM careers while also engaging their teachers. Our Robert Noyce Teacher Scholarship program encourages talented STEM students and professionals to pursue teaching careers in elementary and secondary schools in high-need districts. Our Scholarships in STEM program provides institutions with competitive awards so that they can provide scholarship support to low-income students who are pursuing associate, baccalaureate, or graduate degrees in STEM. Our Advanced Technological Education program supports education for the skilled technical workforce. At the graduate level, NSF programs provide fellowships to students in STEM fields (Graduate Research Fellowships) and awards to institutions that allow them to provide scholarships or traineeships to students in STEM fields. The Cybercorps®: Scholarship for Service program requires that scholarship recipients take jobs in cybersecurity-related positions in government for the same duration as their scholarships.

Questions for NSF: Dr. Karen Marongelle

STEM INITIATIVES FOR NON-TRADITIONAL STUDENTS

A diverse STEM workforce is key to our nation’s economic success. To remain competitive, the U.S. needs STEM-capable workers at every education level and from every background. And yet, often when we think of STEM initiatives, we think of programs designed for traditional K-12 students, undergraduates, and graduates.

8. How is the National Science Foundation working to broaden STEM education opportunities for non-traditional students and underrepresented populations such as veterans, part-time students, online students, and older students?

Response: NSF is working to make STEM education opportunities available to all students and continuously seeks to identify and disseminate the effective methods of making STEM accessible to students and providing opportunities for students to succeed in STEM. For instance, STEM learning opportunities in informal environments can contribute to STEM education for the entire community, no matter one's age or educational background. Our program on Advancing Informal STEM Learning (AISL) supports these out-of-school experiences and the research on understanding what is most effective in providing STEM opportunities in out-of-school environments. The Advanced Technological Education program serves many non-traditional students at two-year colleges and provides unique opportunities for students to re-skill in emerging STEM fields in programs tightly connected with industry. NSF programs for institutions that serve students who have not had opportunities to thrive in STEM include the Historically Black Colleges and Universities Undergraduate Program, the Tribal Colleges and Universities program, and the Hispanic-Serving Institutions program; these programs provide opportunities for students to excel in STEM at institutions that have proven track records of supporting minority students. NSF INCLUDES is our newest, boldest vision intended to develop STEM talent from all sectors and groups in our society. One of the NSF 10 Big Ideas, NSF INCLUDES seeks to scale-up proven practices in serving students who have not had access to opportunities to succeed in STEM, including non-traditional students, underrepresented students, and veterans. NSF has partnered with The Boeing Company as a partner in NSF INCLUDES to focus on increasing the number of women in STEM fields, particularly women returning to the STEM workforce, especially veterans.

NSF has also partnered with The Boeing Company to accelerate training in critical skill areas in STEM fields, and in particular to re-skill existing employees. As part of this partnership, the *EHR Core Research: Production Engineering Education and Research* (ECR: PEER) initiative was launched in FY19 to support foundational research arising from the design, development, and deployment of creative online curricula that provide learners at various levels with skills in five focal areas: model-based systems engineering, software engineering, mechatronics, data science, and artificial intelligence. ECR: PEER invited proposals to design, develop, deploy, and study the effectiveness of online courses in any one of these focal areas using the theories and tools of the learning sciences. Additionally, ECR: PEER welcomed proposals to convene experts in the academic, for-profit, and non-profit sectors to imagine the future of production engineering education for one of the five focal areas.

9. What recruitment, retention, and advancement practices has NSF found to be successful for non-traditional students?

Response: Through its programs, NSF continually explores and evaluates these practices to discover which practices are effective for whom, and in what circumstances. We have learned, for instance, that scholarship funding alone, while necessary, is not sufficient for keeping students on track to achieve their STEM goals. Students also need supports such as mentors, early research experiences, and a cohort community to enable them to succeed.

ADVANCED TECHNICAL EDUCATION

This summer, the National Science Board released a report titled, “The Skilled Technical Workforce: Crafting America’s Science & Engineering Enterprise,” which identifies opportunities and challenges facing the skilled technical workforce in the United States. Skilled technical workers – or workers who use technical skills in their jobs but do not have a four-year degree – are in high demand and are essential to our nation’s future competitiveness.

10. Please explain the challenges facing the U.S.’s skilled technical workforce and how the National Science Foundation – and the Advanced Technological Education Program in particular – is working to address these challenges?

Response: Rapid changes in the nature of work, education, technology, workforce demographics, and international competition have led the National Science Board to conclude that our competitiveness, security, and research enterprise require the skilled technical worker - a critical, but often overlooked segment of our STEM-capable workforce. A National Academies of Sciences, Engineering, and Medicine report predicts a shortfall of nearly 3.4 million skilled technical workers by 2022. NSF is attending to the four recommendations in the report, which are:

Change the message. Both NSF and the EHR directorate have communications strategies to engage and inform our communities.

Focus on the data: The Innovations in Mentoring, Training, and Apprenticeships Act (2018) required that “The National Center for Science and Engineering Statistics of the National Science Foundation shall consult and coordinate with other relevant Federal statistical agencies, including the Institute of Education Sciences of the Department of Education, and the Committee on Science, Technology, Engineering, and Mathematics Education of the National Science and Technology Council established under section 101 of the America COMPETES Act of 2010 (Public Law 111–358), to explore the feasibility of expanding its surveys to include the collection of objective data on the skilled technical workforce.” The Act includes a requirement for a plan for multi-agency collaboration to improve data collection and reporting of data on the skilled technical workforce.

Leverage the portfolio of federal investments: This effort is a part of the work of FC-STEM.

Build partnerships: The ATE program involves partnerships between academic institutions (grades 7-12, institutions of higher education) and industry to promote improvement in the education of science and engineering technicians at the undergraduate and secondary school levels. The ATE program supports curriculum development, professional development of college faculty and secondary school teachers, career pathways, and other activities. The curricular focus and the activities of all projects contribute to producing more qualified science and engineering technicians to meet workforce demands and improve the technical skills and the general STEM preparation of these technicians and the educators who prepare them. Fields of technology supported by the ATE program include, but are not limited to, advanced manufacturing technologies, agricultural and biotechnologies, energy and environmental technologies, engineering technologies, information technologies, micro- and nano-technologies, security technologies, geospatial technologies,

and applied research on technician education that informs all supported areas. The ATE program encourages projects addressing issues in rural technician education and projects that broaden the diversity of the entry-level technical workforce including strategies to recruit veterans into technician education programs. Because ATE awards are made primarily to two-year colleges, they reach a disproportionately large number of non-traditional students such as underserved students, part-time working students, older students, and veterans.

11. How will NSF ensure that all areas of the country benefit from these programs? And, what can be done to improve participation in these programs?

Response: NSF provides funding for skilled technical workers in every Directorate. While ATE is the signature program providing research and development funding for any type of skilled technical work, all Directorates at NSF support the STW. All parts of the country are eligible to apply to NSF's programs and NSF's programs work to balance their portfolios geographically, as consistent with the results of NSF's merit review process. In addition, NSF's Established Program to Stimulate Competitive Research (EPSCoR) enhances the research competitiveness of targeted jurisdictions (states, territories, commonwealths) by strengthening STEM capacity and capability. Eligibility for this program is based on the (low) level of NSF research funding.

The ATE program, in addition to other programs at NSF, conducts outreach to communities across the states and territories to ensure that a wide range of constituents has access to information about NSF programs. In EHR, we have begun an outreach campaign to clusters of institutions who have not had success in EHR competitions. By conducting targeted outreach, we expect to improve participation in our programs.

Questions for NASA: Mr. Mike Kincaid

CHANGES TO SPACE GRANT

Recently, NASA proposed changes to the Space Grant program for fiscal years 2020 through 2024. Such changes include removing the distinction between designated and non-designated states and reducing annual funding to support Mission Directorate competitions.

12. Given that I represent a designated Space Grant state that stands to lose funding with these proposed changes, can you take a moment to explain what drove NASA to make changes to Space Grant?
13. The original Congressional approach for Space Grant focused on (1) NASA needs, (2) national STEM needs, and (3) State STEM needs. The original Congressional model focuses all of the competition at the state level in order to best address the state STEM needs. Does NASA's new model adequately cover all three areas?
14. In the past, NASA has periodically accepted applications from undesignated State Space Grant Consortia seeking designated status. Why did NASA not follow past practices of establishing performance criteria to identify the most deserving states for the upgrade from undesignated to designated status? Why was this not done over a period of years so that the designated states, who are doing outstanding work, did not have to take a funding cut?

15. If Congress were to provide additional funding for Space Grant in FY 2020, will the additional money be allocated to the states as *base* funding without the need to further increase Mission Directorate projects or NASA OSTEM administrative fee? Does NASA have any new plans for using added Congressional funding increases that you have not discussed?
16. Since the beginning of the Space Grant program, states which wanted to participate had to step up and provide funding for their consortia in order to become “designated.” This state buy-in has been a key component to the program. Now that NASA is leveling the playing field by making all states eligible for these funds, how much state funding nationwide does NASA expect will be lost to the consortia?
17. NASA has an administration fee of approximately 10-15% of the total Congressional award, despite consistent Congressional guidance to reduce administrative fees to 5%. Is this fee excessive realizing that money held back at OSTEM to run the program is not getting to the students? What is NASA doing to reduce the administrative fee?
18. Please explain NASA’s plans for the new Mission Directorate projects. In particular, has NASA identified the topics and secured the funding with the Mission Directorates to make this a success? Regarding the topics, did NASA work with the Space Grant Directors to identify and select topics that best meet the STEM state needs and utilize the expertise of Space Grant? Did NASA work with the Space Grant Executive Committee to find an acceptable funding level? Will the Mission Directorates provide all of the needed infrastructure to ensure that this program is a success? What are NASA’s plans if the Mission Directorate commitment is not met? Will the resulting unused funds be returned to the Space Grant Consortia?

ARTEMIS MISSION AND ITS IMPACT ON STEM ENGAGEMENT

On March 26th, at a meeting of the National Space Council in Huntsville, Alabama, Vice President Pence announced that the United States would return astronauts – including the first female – to the South Pole of the Moon by 2024.

19. Mr. Kincaid, you mention in your testimony that NASA envisions having students across the nation join in the Artemis journey. Can you take a moment to explain what that means from a STEM engagement perspective?
20. How is NASA using missions like Artemis, as well as its astronauts and scientists, to excite children – especially young girls – to get them more interested in math and science? And, to eventually pursue careers in STEM?
21. Do you think the Artemis program could influence the nation’s next wave of technological breakthroughs?

The Honorable Tom Graves
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
Science, Technology, Engineering, and Mathematics (STEM) Engagement Hearing

1. Can you report on the Committee on STEM Education (CoSTEM)'s progress in the implementation of the STEM Education Strategic Plan?

Response: CoSTEM recently released a Progress Report on the Federal Implementation of the STEM Education Strategic Plan. This report is available at <https://www.whitehouse.gov/wp-content/uploads/2019/10/Progress-Report-on-the-Federal-implementation-of-the-STEM-Education-Strategic-Plan.pdf>

Since the release of the STEM Education Strategic Plan in December 2018, five Interagency Working Groups (IWGs) have been appointed, developed work plans, and are carrying out their work plans.

2. What metrics will determine success in STEM engagement?

The Interagency Working Group on Transparency and Accountability has undertaken activities to move forward three objectives in FY 20:

- Report participation rates of underrepresented groups across CoSTEM programs;
- Use common metrics to measure progress; and
- Make program performance and outcomes publicly available.

This work will lay the foundation for reporting on success in STEM engagement across CoSTEM programs.

3. What strategies are in place for supporting and growing the STEM teaching workforce, especially at middle and high school levels?

Response: Many programs across the CoSTEM agencies focus on supporting and growing the STEM teaching workforce. In addition, specific Interagency Working Group actions are designed to support and grow the STEM teaching workforce. For instance, the Interagency Working Group on Convergence is undertaking activities that teach educators effective methods for making entrepreneurship education more inclusive, support programs and partnerships that integrate mathematics and statistics education in meaningful contexts in educator upskilling, and supporting teachers in building transdisciplinary approaches in their teaching practice.

4. How will we improve diversity in STEM engagement?

Response: A list of how the CoSTEM agencies' programs align with the goal to increase diversity, equity, and inclusion in STEM is included in Appendix 2 of the Progress Report on the Federal Implementation of the STEM Education Strategic Plan. Eighty-three programs fully or

partially align with the goal to increase diversity, equity, and inclusion in STEM across the CoSTEM agencies.

Additionally, several federal agencies have joined the NSF INCLUDES National Network. Through this partnership, our agencies will be rowing in the same direction to improve diversity in STEM engagement. Sharing resources, best practices, and people, the targeted focus and collective impact will move the needle on improving diversity in STEM.

5. What strategies and metrics are in place?

Response: Across the 83 programs mentioned above, numerous strategies are employed to improve diversity in STEM, across all age groups, regions of the country, and involving persons of diverse backgrounds. The Interagency Working Group on Transparency and Accountability is working closely with the Interagency Working Group on Inclusion in STEM to develop metrics to track the progress of improving diversity in STEM across the CoSTEM programs.

6. What is the role of higher education in increasing STEM engagement?

Response: Higher education plays a critical role in increasing STEM engagement, from conducting research on effective strategies for increasing STEM engagement, to preparing teachers to teach the next generation of STEM students, to making discoveries that inspire future generations of STEM learners.

The Honorable Robert Aderholt
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
Science, Technology, Engineering, and Mathematics (STEM) Engagement Hearing

Questions for NSF and NASA: Dr. Karen Marongelle and Mr. Michael Kincaid

STEM INVESTMENTS IN RURAL COMMUNITIES

Studies show that STEM education can provide workers with better employment opportunities that command wages above – and often double – the national average. And yet, millions of students in rural areas today face barriers to accessing high-quality STEM education. Such barriers include: teacher retention and shortages of mathematics and science teachers; inadequate resources; and limited access to broadband services.

1. In your opinion, what are the biggest barriers students in rural areas face in accessing high-quality STEM education?

Answer: NASA recognizes that students in rural areas face many challenges in accessing high-quality STEM education, including limited access to resources and high-quality teachers, lack of broadband services, and a lack of connection to mentors and experiences of STEM professionals. The many barriers faced by rural students are best articulated by some of our federal partners who have greater explicit focus on the barriers faced by students in rural communities, including the National Science Foundation and the US Department of Agriculture. NASA partners with these federal colleagues through FC-STEM, and is leveraging their expertise in current work toward the new federal STEM education strategic plan.

The Transparency and Accountability IWG under FC-STEM, of which NASA is a member, is currently focused on establishing common definition(s) of rural areas, and/or approaches to ascribing rural status, as the first step to effectively tracking and reporting participation rates. By establishing common definitions for rural status across federal agencies, FC-STEM will directly support its goal of increasing diversity, equity, and inclusion in STEM education, and help ensure a better understanding of access to STEM education resources across all federal agencies involved in STEM.

2. What is your agency doing to provide more opportunities in STEM education for students in rural areas and to broaden participation in STEM programs nation-wide? And, how does your agency evaluate the effectiveness of these programs and initiatives?

Answer: NASA's STEM Engagement program funds the National Space Grant College and Fellowship Program (Space Grant), which supports consortia in all 50 states, the District of Columbia, and Puerto Rico. Space Grant brings together over 1,000 affiliate organizations including colleges and universities, museums and science centers, and the aerospace industry, which provide students with opportunities to engage in NASA's mission across the country.

NASA's STEM Engagement program also supports NASA's Established Program to Stimulate Competitive Research (EPSCoR) Project. Five Federal agencies conduct EPSCoR programs, including NASA. NASA EPSCoR provides funding to states that have not, in the past, participated equably in competitive aerospace-related research activities. Twenty-five states, Puerto Rico, the US Virgin Islands, and Guam are currently eligible for EPSCoR funding. EPSCoR helps NASA provide support to institutions and students that are often located in rural areas.

To broaden the reach of our opportunities, NASA uses a variety of communication strategies to ensure students, teachers, and institutions are aware of its STEM engagement resources. The opportunities and resources offered by NASA's STEM Engagement program can be found online, including informational videos, lesson plans, teacher professional development webinars, and opportunities to participate in student challenges and activities. To find out more about our opportunities, visit: <https://www.nasa.gov/stem/>. NASA also publishes a weekly digital newsletter, called NASA Express, which highlights the latest opportunities to engage with NASA STEM. NASA Express currently reaches approximately 40,000 educators across the country. To sign-up for NASA Express, visit: <https://blogs.nasa.gov/educationexpress/>.

The Office of STEM Engagement (OSTEM) has a comprehensive performance management strategy that guides the evidence (i.e., milestone accomplishments, performance and participation data, evaluation outcomes, and/or other metrics) that is collected on an annual basis to understand the effectiveness of its programs. OSTEM collects performance and participation data on these investments in accordance with the law. The types of data collected depend on the type of student being served (e.g. K-12 student, undergraduate, graduate, or informal learner) and the program through which the data is collected.

Additionally, OSTEM contributes to and leverages the expertise within the federal interagency working group (IWG) on Transparency and Accountability under FC-STEM. Collectively, the Transparency and Accountability IWG members are working to improve measurement and evaluation across the federal agencies with investments in STEM education.

FIVE-YEAR STRATEGIC STEM PLAN

Last December, the Administration released its five-year strategic plan for STEM education titled "Charting a Course for Success: America's Strategy for STEM Education." The plan calls for building strong foundations for STEM literacy, increasing diversity and inclusion in STEM, and preparing the STEM workforce for the future.

3. How does annual NSF and NASA funding help to carry out this five-year plan and assist you in your role on FC-STEM?

Answer: Under the new Federal STEM education strategic plan, all federal agencies, including NASA, have an opportunity to leverage their unique assets and expertise in carrying out the collective goals of the strategic plan. NASA's appropriated investments in STEM engagement support all three goals of the strategic plan (see *Progress Report on the Federal Implementation of the STEM Education Strategic Plan* released in October 2019,

<https://www.whitehouse.gov/wp-content/uploads/2019/10/Progress-Report-on-the-Federal-Implementation-of-the-STEM-Education-Strategic-Plan.pdf>). NASA staff provide their expertise to interagency working groups that are dedicated to collectively fulfilling the goals and objectives of the strategic plan, while also fulfilling their primary responsibilities in support of NASA's STEM Engagement efforts. NASA has also benefited from its relationships with other agencies, particularly as OSTEM worked to develop a new performance management strategy and leveraged the expertise of NSF employees experienced in the work of measurement and evaluation.

4. Given this significant federal investment, how is FC-STEM working to ensure that federal STEM efforts are not duplicated? And, that there is coordination among agencies on how federal dollars are being spent on STEM initiatives?

Answer: FC-STEM supports the day-to-day execution of the federal STEM education strategic plan across the federal government, and serves as the primary coordinating body between education leaders across the federal government. Within FC-STEM, five interagency working groups (IWGs) bring together federal agencies with expertise specific to the goals and pathways of the new strategic plan. Collectively, FC-STEM and its IWGs ensure open lines of communication between agencies to ensure that federal investments are complementary, and not duplicative, and that the knowledge and assets of each agency can be leveraged to collectively improve and amplify federal appropriations for STEM education.

5. Is your agency looking into how public-private partnerships may leverage our federal STEM initiatives?

Answer: OSTEM leverages public-private partnerships in a variety of ways to execute its STEM engagement efforts.

FC-STEM has a federal interagency working group (IWG) focused on strategic partnerships, known as the "Strategic Partnerships IWG." While the group is not exclusively focused on public-private partnerships, the working group is currently working to better understand how to leverage local and regional STEM ecosystems to provide students with improved STEM education opportunities. STEM ecosystems consist of many types of partners, including federal agencies, schools, informal learning sites such as libraries, parks, and museums, state and local government organizations, and industry partners.

INTERNATIONAL COMPETITIVENESS

According to the National Science Board's Science and Engineering Indicators report for 2018, last year, STEM bachelor's degree awards totaled more than 7.5 million globally.

Half of these degrees were conferred in India (25%) and China (22%), 20% were conferred in the European Union, and then only 10% were conferred in the United States.

6. Are you concerned that the lagging number of degrees conferred in the U.S. compared to other countries could impact our economic competitiveness? Especially with countries like China?

Answer: A pool of eligible, well-qualified candidates to fill open positions in STEM disciplines is vital to an innovative and competitive U.S. economy.

7. To create a more capable workforce, how is your agency using federal dollars to encourage students to pursue STEM degrees and remain working in these fields?

Answer: NASA has a diverse portfolio of activities dedicated to attracting, engaging and educating students and to supporting educators and educational institutions across the nation. These range from internships and fellowships, research and development (R&D) opportunities, challenges and competitions, pre-college and college STEM experiences, virtual learning, educator and faculty support, as well as institutional support. In FY2018, over 820,000 students participated in NASA STEM engagement activities from elementary students to post-doctoral scholars, and over 180,000 educators participated in NASA professional development activities. NASA's portfolio of activities provides support for learning across all grade levels, and undergraduate and graduate students. These activities inspire and engage students to pursue STEM degrees, and provide them with skills and support to prepare them for their work in STEM careers. The experiences students gain in internships and fellowships are vital in enabling these students to be successful in remaining and advancing in the STEM workforce. These opportunities that leverage the unique and inspirational mission of NASA would not be possible without federal dollars.

Questions for NASA: Mr. Mike Kincaid

CHANGES TO SPACE GRANT

Recently, NASA proposed changes to the Space Grant program for fiscal years 2020 through 2024. Such changes include removing the distinction between designated and non-designated states and reducing annual funding to support Mission Directorate competitions.

12. Given that I represent a designated Space Grant state that stands to lose funding with these proposed changes, can you take a moment to explain what drove NASA to make changes to Space Grant?

Answer: When Congress directed NASA to create Space Grant in 1989, NASA initially provided funding to 25 states. Over time, NASA received additional appropriations for Space Grant, and states were given the opportunity to graduate from a non-designated to a designated state and would therefore receive additional funding. However, the last time states had been given the opportunity to compete to become a designated state was in 2004. The 17 states that did not have access to additional funding were concerned by their lack of access to additional funds, and the states that had been through the process of competing for designated funding had voiced concerns that the process was onerous and time-consuming. Therefore, OSTEM made the decision to provide additional funding to the 17 previously non-designated states by making small cuts to the budgets in the 35 states previously considered designated.

13. The original Congressional approach for Space Grant focused on (1) NASA needs, (2) national STEM needs, and (3) State STEM needs. The original Congressional model focuses all of the competition at the state level in order to best address the state STEM needs. Does NASA's new model adequately cover all three areas?

Answer: NASA believes that the new model enhances the capacity to serve all three areas of focus (i.e. NASA's needs, national STEM needs, and State STEM needs). NASA will continue to work with the Consortia for implementation of the program that uniquely services both NASA and State needs.

14. In the past, NASA has periodically accepted applications from undesignated State Space Grant Consortia seeking designated status. Why did NASA not follow past practices of establishing performance criteria to identify the most deserving states for the upgrade from undesignated to designated status? Why was this not done over a period of years so that the designated states, who are doing outstanding work, did not have to take a funding cut?

Answer: Congress has not required that NASA expand the number of Designated states since 2004. Over the intervening 15 years, the Consortia have expanded their respective reach. Based upon the most recent metrics, the non-designated states were performing at the same levels as designated states in terms of reach of their respective programs and the types of direct student awards offered, despite not having the additional funding of a designated Consortium (~\$190,000 during the last award period). Additionally, there are substantial costs incurred by NASA and the Consortia to convene review panels to expand the number of Designated states.

As NASA is seeking to implement a new model for the operation of Space Grant, the additional time and resources necessary to convene a panel to expand the number of Designated states seemed too much to attempt during the next grant period, given that it would be likely that all Non-designated states would graduate to Designated.

15. If Congress were to provide additional funding for Space Grant in FY 2020, will the additional money be allocated to the states as *base* funding without the need to further increase Mission Directorate projects or NASA OSTEM administrative fee? Does NASA have any new plans for using added Congressional funding increases that you have not discussed?

Answer: The President’s Budget proposes to terminate funding for OSTEM, including Space Grant, to redirect resources to NASA’s core mission of exploration. In the event that Congress appropriates additional funding relative to the 2019 enacted level for Space Grant, NASA would allocate any additional funding to the States. Funding to manage Space Grant has remained relatively stable in FY 2017, 2018, and 2019, and we do not foresee any major changes that would require additional funding to manage Space Grant at NASA.

16. Since the beginning of the Space Grant program, states which wanted to participate had to step up and provide funding for their consortia in order to become “designated.” This state buy-in has been a key component to the program. Now that NASA is leveling the playing field by making all states eligible for these funds, how much state funding nationwide does NASA expect will be lost to the consortia?

Answer: For Space Grant base awards to the 52 eligible Space Grant Consortia members, NASA has maintained that each member continue to cost match at the same level specified under Title 51, United States Code: “not more than 66 percent of the total cost” of each program can use federal funding. Further, since the total amount of base awards was maintained after the “Designated” and “Non-Designated” approach was modified to allow equal funding to each member (approximately 1% variation to fund Guam and the US Virgin Islands at a lower non-member level), no significant cost matching from Space Grant Consortia members is expected to be lost.

17. NASA has an administration fee of approximately 10-15% of the total Congressional award, despite consistent Congressional guidance to reduce administrative fees to 5%. Is this fee excessive realizing that money held back at OSTEM to run the program is not getting to the students? What is NASA doing to reduce the administrative fee?

Answer: NASA continues to administer the Space Grant Program with an overhead level above 5%, but less than 10%. This overhead level is necessary to ensure that Space Grant Program administration can proceed in accordance to all related legislation, while influencing high-quality and consistent performance across the consortia, and maintaining the appropriate infrastructure to solicit and receive proposals, review submittals, make awards, track the performance of awardees, and ensuring compliance throughout each award period.

NASA does not consider the current overhead rate to be excessive; as a comparison, based on FY 2018 values reported by the Space Grant consortia, the median rate of award funds that goes towards administrative functions for each consortia member is approximately 23%. NASA's efforts covered by this overhead funding contributes to maximizing the alignment of nationwide Space Grant activities with Agency and National STEM goals.

NASA does continuously identify and evaluate opportunities to lower overhead rates without adversely affecting the Agency's ability to maintain strong leadership, and sound management approaches, and hopes to lower the overhead rate over time. However, NASA does not consider 5%, or less, as the overhead rate to be an attainable goal.

18. Please explain NASA's plans for the new Mission Directorate projects. In particular, has NASA identified the topics and secured the funding with the Mission Directorates to make this a success? Regarding the topics, did NASA work with the Space Grant Directors to identify and select topics that best meet the STEM state needs and utilize the expertise of Space Grant? Did NASA work with the Space Grant Executive Committee to find an acceptable funding level? Will the Mission Directorates provide all of the needed infrastructure to ensure that this program is a success? What are NASA's plans if the Mission Directorate commitment is not met? Will the resulting unused funds be returned to the Space Grant Consortia?

Answer:

NASA is working to increase alignment between OSTEM activities and the technical needs of NASA's Mission Directorates through strategic partnerships with Mission Directorates. These partnerships allow students to generate innovative ideas and novel solutions that directly align with the largest technical challenges facing the Agency.

NASA did seek input on the Mission Directorate project topics directly from the Consortia via a request for information that was released in July 2019. Also, NASA hosted a session completely devoted to this topic during the Office of STEM Engagement's inaugural PI meeting in August 2019. NASA also met with the Space Grant Executive Committee to discuss the total funding levels of this initiative. NASA reserves the right to augment the Consortia awards with any unused funds.

ARTEMIS MISSION AND ITS IMPACT ON STEM ENGAGEMENT

On March 26th, at a meeting of the National Space Council in Huntsville, Alabama, Vice President Pence announced that the United States would return astronauts – including the first female – to the South Pole of the Moon by 2024.

19. Mr. Kincaid, you mention in your testimony that NASA envisions having students across the nation join in the Artemis journey. Can you take a moment to explain what that means from a STEM engagement perspective?

Answer: NASA is working to increase alignment between OSTEM activities and the technical needs of NASA’s Mission Directorates through strategic partnerships with Mission Directorates. These partnerships allow students to generate innovative ideas and novel solutions that directly align with the largest technical challenges facing the agency, such as landing the first woman and the next man on the Moon by 2024 via the Artemis program.

One example is Artemis Student Challenges, which engage students in activities designed to contribute to NASA’s efforts to return humans to the moon. For example, NASA’s Micro-g Neutral Buoyancy Experiment Design Teams (Micro-g NExT) challenges undergraduate students to design, build, and test a tool or device that addresses an authentic, current space exploration challenge. The overall experience includes hands-on engineering design, test operations, and public outreach. Test operations are conducted in the simulated microgravity environment of the NASA Johnson Space Center Neutral Buoyancy Laboratory. For more about this challenge and other Artemis challenges, visit the Artemis Student Challenges website: <https://www.nasa.gov/stem/artemis.html>

20. How is NASA using missions like Artemis, as well as its astronauts and scientists, to excite children – especially young girls – to get them more interested in math and science? And, to eventually pursue careers in STEM?

Answer: As NASA prepares to land the first woman and the next man on the Moon by 2024, we envision having students across the nation join us on our journey. Through NASA’s efforts in STEM engagement, and in partnership with the Mission Directorates, NASA scientists, technologists and engineers, NASA will provide a diverse set of learning opportunities and serve as mentors and sponsors for internships and fellowships. NASA also strives to ensure that our astronauts, leaders, scientists, and engineers serve as role models for all students. As the Artemis program continues to move through development and implementation, in partnership with the mission directorates and their programs, NASA will leverage its STEM Engagement investments to enable opportunities for students to contribute to NASA’s work in going to the Moon and on to Mars.

With appropriated funds, NASA has supported the NASA Museum Alliance, which has over 1,200 member organizations across the U.S. and over 130 outside the U.S. in 37 countries. NASA has also funded a competitive award program called Teams Engaging Affiliated Museums and Informal Institutions (TEAM II) for museums and science centers, providing inquiry- and/or experiential-based educational opportunities in direct alignment with NASA missions for students in grades 4-8. Recent solicitations have focused on Artemis content and learning opportunities.

NASA has also supported the development of “STEMonstrations,” a series of demonstration videos recorded onboard the International Space Station. Through STEMonstrations, NASA’s astronauts provide students with engaging lessons that demonstrate scientific content in the microgravity environment. Lesson plans have also been developed to complement the videos for classroom use. For more information on STEMonstrations, visit the STEMonstrations website: <https://www.nasa.gov/stemonstrations>

21. Do you think the Artemis program could influence the nation's next wave of technological breakthroughs?

Answer: The Artemis program is well positioned to influence the nation's next wave of technological breakthroughs. The Artemis program will bring together the capabilities and resources of our international and commercial partners and inspire the next generation of learners around the world.

As an example, the 2020 Breakthrough, Innovative and Game-changing (BIG) Idea Challenge provides undergraduate and graduate students the opportunity to design, build, and test a low-cost sample payload targeted for delivery to the lunar surface. This competition is intended to be an open innovation challenge with minimal constraints so that proposing teams can genuinely create and develop out-of-the-box solutions.

NASA has a track record in technological breakthroughs that have been vital in achieving NASA's mission that have also led to innovations in our homes and cities and the development of private industry. For an interactive overview of the ways in which NASA technologies make an impact on our daily lives, visit the NASA Home and City website: <https://homeandcity.nasa.gov/>. NASA's Technology Transfer Program also publishes an annual publication titled *Spinoff*, which explores some of the latest NASA technology that is benefitting life on earth. Learn more about NASA's Technology Transfer Program and read *Spinoff* at this link: <https://spinoff.nasa.gov/>.

The Honorable Tom Graves
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
Science, Technology, Engineering, and Mathematics (STEM) Engagement Hearing

1. Can you report on the Committee on STEM Education (CoSTEM)'s progress in the implementation of the STEM Education Strategic Plan?

Answer: Since the release of the new Federal STEM Education Strategic Plan in December 2018, CoSTEM has guided its Federal Coordination in STEM Education (FC-STEM) subcommittee to develop an implementation plan that will support the execution of the strategic plan. Early in 2019, FC-STEM conducted a data call through which agencies identified actions that support the objectives of the new strategic plan. Through the data call, agencies committed to both individual and collaborative actions that will support the fulfillment of the goals and objectives of the strategic plan.

The data was also used by FC-STEM to support the development of new interagency working groups (IWGs) that will facilitate collaborative work toward the goals and objectives of the plan. FC-STEM stood-up five interagency working groups, focused on the goals and pathways outlined in the strategic plan: Strategic Partnerships, Convergence, Computational Literacy, Inclusion in STEM, and Transparency and Accountability. The IWG members used the data to identify actions that could be amplified through interagency collaboration, along with actions that fill gaps or solve problems across the federal portfolio. In consultation with FC-STEM, the IWGs have finalized their work plans and are executing work toward the goals and objectives of the strategic plan.

For more detailed information about CoSTEM's progress, view its recent progress report: <https://www.whitehouse.gov/wp-content/uploads/2019/10/Progress-Report-on-the-Federal-Implementation-of-the-STEM-Education-Strategic-Plan.pdf>.

2. What metrics will determine success in STEM engagement?

Answer: NASA defines metrics for its STEM engagement investments through the development of performance goals and annual performance indicators in alignment with NASA's 2018 Strategic Plan, the NASA STEM Engagement performance and evaluation strategy (learning agenda) and in support of the Federal STEM Strategic Plan. Annually, a body of evidence (i.e., milestone accomplishments, performance and participation data, evaluation outcomes, and/or other metrics) is generated to assess progress of the STEM Engagement activities/actions in achieving performance goals and annual performance indicators. The following describes the planned FY 2020 high-level performance goals and annual performance indicators:

- Performance Goal: Provide opportunities for underrepresented students in STEM fields to engage with NASA's aeronautics, space, and science professionals, content, and facilities in support of a diverse future NASA and aerospace industry workforce.
 - Annual Performance Indicator: Meet or exceed the national average in two of the four categories of student diversity for NASA STEM enrollees.

- Performance Goal: Enhance the effectiveness of education investments using performance assessment and evaluation-driven processes.
 - Annual Performance Indicator: Achieve milestone(s) in the implementation of performance assessment and evaluation for STEM engagement investments. The milestone is to award a competitive agreement to conduct a multi-year, third-party, project-level evaluation of the National Space Grant College and Fellowship Project.
- Performance Goal: Provide opportunities for students to contribute to NASA’s aeronautics, space, and science missions and work in exploration and discovery.
 - Annual Performance Indicator: Number of paper presentations, peer-reviewed research publications, and *(beginning in FY2021 to include student proposed solutions and products)* resulting from STEM engagement investments.

3. What strategies are in place for supporting and growing the STEM teaching workforce, especially at middle and high school levels?

Answer: NASA provides support to teachers and institutions in order to reach the ultimate beneficiaries of its STEM engagement efforts – students. In FY2018, over 180,000 educators participated in NASA professional development activities. These activities include in-person and virtual professional development activities offered by NASA’s community of talented and dedicated education professionals and technical experts. All of the opportunities and resources NASA offers to teachers can be found online, including informational videos, lesson plans, teacher professional development webinars, and opportunities for their students to participate in student challenges and activities.

For example, NASA funds the NASA STEM Educator Professional Development Collaborative (EPDC) through a cooperative agreement. EPDC provides professional development to teachers by leveraging NASA-unique resources and innovative assets that are only available at NASA centers, such as space launch and engine testing facilities and astronaut training centers. EPDC also provides access to NASA classroom lessons, activities, and resources that educators can utilize with students, including existing STEM engagement lesson plans and activities, and access to service capabilities at the NASA centers nationwide. EPDC regularly provides professional development webinars that allow educators to learn more about NASA content and resources without the need to travel to a NASA center. Find out more about the opportunities offered through EPDC at its website: https://www.nasa.gov/offices/education/programs/descriptions/NASA_STEM_EPDC_Collaborative.html.

NASA’s “STEMonstrations,” a series of demonstration videos recorded onboard the International Space Station, provides students with engaging lessons that demonstrate scientific content in the microgravity environment. Lesson plans have also been developed to complement the videos for classroom use. For more information on STEMonstrations, visit the STEMonstrations website: <https://www.nasa.gov/stemonstrations>.

4. How will we improve diversity in STEM engagement?

Answer: NASA Offices, Mission Directorates, Centers and Facilities collaborate to implement a single Agency-wide approach to STEM engagement. This approach provides unique NASA experiences to students, educators, and institutions, as well as streamlined access to NASA content, websites, people, resources, and facilities. NASA internships and fellowships provide mechanisms for recruiting underrepresented students to STEM careers, including careers at NASA.

As noted above, NASA's performance goals and indicators include a focus on providing opportunities for underrepresented students in STEM fields to engage with NASA's aeronautics, space, and science professionals, content, and facilities in support of a diverse future NASA and aerospace industry workforce. NASA will continue to monitor its efforts to engage students and improve diversity in STEM engagement, including women and other underrepresented and underserved groups, using these measures as a stepping stone for improved and expanded STEM engagement efforts. Consistent with goals of the Administration's STEM education strategic plan, NASA recognizes the need to improve tracking and reporting on the participation of underrepresented groups in NASA programs to gauge the effectiveness of its activities at fostering diversity and inclusion.

Within the Office of STEM Engagement, the Minority University Research Education Project (MUREP) funds competed awards to Minority Serving Institutions (MSIs) that foster innovative engagements with NASA's Subject Matter Experts (SMEs) as well utilization of NASA's unique content. One of MUREP's activities known as NASA Community College Aerospace Scholars (NCAS) focuses on STEM competitions for 2-year college students that are not all pursuing STEM degrees. Over 70% of the student engagement is from MSIs. By exposing these students to STEM through online lessons, team projects and visits to NASA Centers, more diverse students choose STEM majors and career paths.

MUREP also partners with NASA's Office of Diversity and Equal Opportunity (ODEO) to participate in STEM based conferences that cater to diverse populations (ie- AISES, NSBE and Great Minds in STEM).

5. What strategies and metrics are in place?

Answer: In 2018, NASA completed a rigorous process to develop a new comprehensive STEM engagement performance and evaluation strategy (Learning Agenda) in alignment with NASA's 2018 Strategic Plan and in support of the Federal STEM Strategic Plan. This Learning Agenda serves as the foundational document for building a culture of learning and continual improvement for NASA STEM engagement efforts.

The implementation of the Learning Agenda provides a systematic approach for building and using new knowledge about project and operational performance for evidence-based decision making and continual improvement while prioritizing three primary Learning Questions aligned to NASA's OSTEM performance goals, priorities and focus areas. The primary purpose of the Learning Questions is to provide technical evidence to fill in gaps in understanding regarding: a) how STEM engagement investments are currently contributing to NASA's missions and work, b) how STEM engagement investments are currently

contributing to the diversity of the future aerospace STEM workforce and c) the extent that enhancements to STEM engagement performance assessment and evaluation have been implemented and the outcomes of implementing an enhanced performance assessment and evaluation strategy.

NASA also has an annual Strategic Review process, which encompasses a review of all performance goals on an annual basis including the NASA OSTEM FY 2020 high-level performance goals and annual performance indicators discussed in the response to Question 2 above.

NASA will continue to seek opportunities to collaborate with other Federal Agencies to coordinate, benchmark and share activity design, implementation and performance measurement and evaluation lessons learned and good practices to improve transparency and increase public awareness of federal program outcomes. NASA contributes to and leverages the expertise within the federal interagency working group (IWG) on Transparency and Accountability under FC-STEM. Collectively, the Transparency and Accountability IWG members are working to improve measurement and evaluation across the federal agencies with investments in STEM education.

6. What is the role of higher education in increasing STEM engagement?

Answer: NASA's Office of STEM Engagement, recently convened a panel of experts to explore what is known about sparking student interest, STEM engagement and student motivation, and to discuss the roles of NASA, higher education partners, and collaborators in sustaining student interest, STEM engagement and student motivation. Participants included professors in Education, Learning, Research, Diversity, and STEM Education and representatives from agencies committed to education, research, science, and technology innovation. The primary finding indicated that *"NASA is well-positioned in the Federal space to play an important role in sparking interest, and to collaborate with other agencies to sustain STEM interest generally."*

NASA collaborates with higher education institutions to increase STEM engagement among K-12 audiences. As an example, through NASA's Minority University Research and Education Project (MUREP) Aerospace Academy (MAA), NASA is able to attract and retain underserved and underrepresented youth in grades K-12. Utilizing curriculum enhancement activities, emerging technologies and family involvement, which are core components of the MAA, MSIs are afforded the opportunity to develop increased STEM awareness and understanding of STEM content and NASA missions by engaging students, family members, and educators in firsthand experiences in STEM at a similar or more advanced level. NASA's STEM Engagement program also funds the National Space Grant College and Fellowship Program (Space Grant), which supports consortia in all 50 states, the District of Columbia, and Puerto Rico. Space Grant brings together over 1,000 affiliate organizations including colleges and universities, museums and science centers, and the aerospace industry, which provide students with opportunities to engage in NASA's mission across the country.

WEDNESDAY, OCTOBER 16, 2019.

**OVERSIGHT HEARING: NASA'S PROPOSAL TO ADVANCE
THE NEXT MOON LANDING BY 4 YEARS**

WITNESSES

**JAMES F. BRIDENSTINE, ADMINISTRATOR, NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION**

**KENNETH D. BOWERSOX, ACTING ASSOCIATE ADMINISTRATOR FOR
HUMAN EXPLORATION AND OPERATIONS, NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION**

Mr. SERRANO. The subcommittee shall come to order.

I would like to welcome NASA Administrator, Jim Bridenstine, and Acting NASA Associate Administrator for Human Exploration and Operations, Kenneth Bowersox, to the subcommittee this morning.

Earlier this year, NASA commemorated the 50th anniversary of the landing on the Moon, which remains the single most successful and famous mission in NASA's history. Just a week before our CJS bill was marked in subcommittee, NASA submitted a \$1.65 billion budget amendment that intended to start the effort to advance the return of humans to the Moon by 4 years. Such little time prevented us from adequately considering the proposal. This hearing will give us an opportunity to obtain more information from NASA regarding its revised plans for returning to the Moon.

While all of us on this subcommittee would like to send the first woman astronaut into deep space, we want to do it in a responsible way—from the perspective of safety, cost, and likelihood of mission success.

As most of you know, I have been a strong supporter of NASA during my 29 years in Congress, and we provided NASA more than \$22.3 billion for fiscal year 2020 in our House bill. However, I remain extremely concerned about the additional cost to accelerate the mission to the Moon by 4 years. Some experts have said an additional financial resources needed to meet the administration-imposed 2024 deadline could exceed \$25 billion over the next 5 years compared to the original 2028 schedule. To date, NASA has not provided the committee with a full cost estimate, despite repeated requests.

At a time of huge financial needs across numerous government programs all competing for funding within the budget caps, an additional \$25 billion cost would severely impact vital programs, not only under this subcommittee, but across all non-defense subcommittees.

Another concern that I have is the lack of a serious justification for such a cost. Since NASA has already programmed the lunar landing mission for 2028, why does it suddenly need to speed up

the clock by 4 years—time that is needed to carry out a successful program from a science and safety perspective.

To a lot of Members, the motivation appears to be just a political one—giving President Trump a Moon landing in a possible second term, should he be reelected.

Not even NASA's own leadership has enough confidence in the success and safety of advancing this timeline. NASA Acting Associate Administrator Bowersox, who is a former astronaut and here with us today, referred to the 2024 Moon landing date as difficult to achieve in a House Science hearing just last month, saying, quote, "I wouldn't bet my oldest child's upcoming birthday present on anything like that."

Additionally, NASA's Manager for the Human Landing System, Lisa Watson-Morgan, was quoted in an article about the timing of the mission saying, quote, "This is a significant deviation for NASA and the government. All of this has to be done on the fast. It has to be done on the quick. Typically, in the past, NASA is quite methodical, which is good. We are going to have to have an abbreviated approach to getting to approval for industry standards for design and construction, and how we're going to go off and implement this. So this is a big shift, I would say, for the entire NASA community too," unquote.

We cannot sacrifice quality just to be quick. We cannot sacrifice safety to be fast. And we cannot sacrifice other government programs just to please the President.

Before asking for such a substantial additional investment, NASA needs to be prepared to state which NASA missions will be delayed or even canceled in the effort to come up with an additional \$25 billion.

Overall, I remain extremely concerned by the proposed advancement by 4 years of this mission. The eyes of the world are upon us; we cannot afford to fail. Therefore, I believe that it is better to use the original NASA schedule of 2028, in order to have a successful, safe, and cost-effective mission for the benefit of the American people and the world.

Thank you once again, Administrator and Acting Associate Administrator, for being with us today, and I look forward to hearing your testimony.

And now I would like to recognize at this time my good friend, the ranking member, Mr. Aderholt, for his opening comments.

Mr. ADERHOLT. Thank you for yielding, Mr. Chairman. And, first of all, I want to thank you for your leadership on this subcommittee, your willingness to have hearings throughout the year, but in particular for this hearing.

Regardless of party labels, the House of Representatives will miss your leadership, your professionalism, and your kindness. And we look forward to working with you, of course, through the rest of this Congress and we have a long way to go. So we know you are not leaving yet, but I would be remiss if I didn't mention that this morning.

I also appreciate the Ranking Member, Kay Granger, being here today, and for her engagement with these issues. She has put a lot of hard work and expertise into defense issues and on the space

issues over the years for her district and her state, and for the country.

And also I would like to express my gratitude to the President and the Vice President for taking a real active interest in NASA. And, compared to other agencies, it represents a very small part of the national budget, but which continues to serve the dreams, it serves the ambitions of the entire Nation, especially young people. And that is evident when I go into schools and have a chance to talk about things related to space and everyone is still very interested in it as ever.

Mr. Administrator, Mr. Bowersox, thank you both for being here today, and I strongly support the President's goal to land the first woman and the next man on the Moon in 2024. In support of that goal, I believe we owe it to the taxpayer and to the mission to make sure the program remains focused. However, to make it to the Moon by 2024, NASA will need sustained congressional investment and taxpayer support.

The Artemis program cannot afford to suffer the kinds of delays, the setbacks, and the cost overruns, which have sometimes become what is known as business as usual in our space program. On the contrary, the Artemis era is supposed to be characterized by unparalleled accountability and agility.

Today, I will have questions regarding whether NASA is still committed to getting to the Moon by any means necessary.

As an ardent supporter of deep space exploration, and also as a fiscal conservative, I am concerned that NASA could undercut its flexibility and incur unnecessary costs by forgoing opportunities to leverage existing assets in an attempt to simultaneously foster a commercial space economy. Director Bridenstine, this past March, Vice President Pence declared in his comments, "If NASA is not currently capable of landing American astronauts on the Moon in 5 years, we need to change the organization, not the mission," and I couldn't agree more.

The administration's ambitious, but critically important, 2024 Moon plan will be the ultimate test of NASA's judgment and its accountability.

Finally, the rockets and the capsules and the transfer vehicles, and the descent and ascent landing systems, must above all be systems which will keep our astronauts alive during the mission and bring them back to Earth safely.

As our Nation embarks on complex new deep space endeavors with unprecedented private sector involvement, safety must be our number one priority. Hence, NASA's ability to ensure safety in the commercial crew program will be a bellwether, and I appreciate the Administrator's comments noting that the commercial crew program must receive the contractor attention it deserves.

So, again, I thank you both for being here today. It is an honor for us to have you here before our subcommittee.

And thank you, Mr. Chairman, for holding this hearing today. And, at this time, I yield back.

Mr. SERRANO. Thank you, Mr. Aderholt, and thank you for your kind comments.

We are honored this morning to have our Ranking Member with us, a person that I respect a lot, and a person that I will remember

for her way of dealing with people in such a friendly and professional way, and bipartisan wherever she could, which was like three percent of the time, but—

[Laughter.]

Only kidding, only kidding. Ms. Granger.

Ms. GRANGER. Thank you. Thank you, Chairman Serrano, and thank you, Ranking Member Aderholt. Thank you for holding this hearing and also for your attention to space and your involvement. I am old enough, I remember the space programs it was where everyone was sitting at their television, their black-and-white television, and watching it, and it was good for America and it was good for all of us.

Welcome, Administrator Bridenstine, and welcome, Mr. Bowersox. Thank you for your stewardship to the National Aeronautics and Space Administration. It is important to all Americans and it is our Nation's space exploration goals.

In March, your agency was challenged with returning our astronauts to the surface of the Moon within the next 5 years. I strongly support this accelerated 2024 goal and the Artemis program, appropriately named after Apollo's twin sister, sending American astronauts, including the first woman, to the south pole of the Moon will showcase the global leadership and technological advances of the United States. It will also enhance our national security by allowing us to establish a strategic presence on the Moon.

Our Nation is facing serious threats in space, specifically from China. I have had classified briefings that would shock any reasonable person and that clearly made the case that we must accelerate the Artemis program.

My advocacy for the Artemis program was solidified after learning about China's capabilities and their future plans. Unfortunately, the U.S. has largely fallen behind in space research and development, and will soon be outpaced by the Chinese if we don't take action immediately.

The only way to protect both our national security and our economy is to dominate space and beat the Chinese and other near-peer adversaries. Space, I believe, is the next high ground, and we have to take it.

The decision to accelerate our Nation's return to the Moon and establish a sustainable presence there will require significant investment by this and future Congresses. As a result, support for this ambitious, but important, 2024 timeline will be accompanied by great expectations, both in terms of schedule, cost, and safety.

Administrator Bridenstine and Mr. Bowersox, we recognize that you have a tough job ahead of you. I am committed to working with you to ensure that NASA can advance our Nation's exploration priorities as effectively and as efficiently as possible. And I look forward to working with Chairwoman Lowey, Chairman Serrano, and Ranking Member Aderholt in funding for NASA's programs as the appropriate process moves forward. And I yield back.

Mr. SERRANO. Thank you.

Before I ask the Administrator for his comments, people who know me would wonder what is wrong with me if I don't do a shout-out here. We spend a lot of time in the city of Washington,

it is like a second home to all of us, so a shout-out to the Nationals for pulling the upset of the century. [Laughter.]

And people thought they couldn't do it. It should be a lesson to all of us—just keep trying and you can pull it off. And now if I can only get the Yankees to turn it around against Houston. [Laughter.]

But, anyway, that is another issue.

Mr. Administrator, 5 minutes. We will include your full statement in the record. So, please, go ahead.

Mr. BRIDENSTINE. Yes, sir. Thank you, Mr. Chairman.

Before I became the NASA Administrator, the President had issued Space Policy Directive No. 1, and that direction was to go to the Moon; to go sustainably; to go with commercial partners and international partners; to utilize the resources of the Moon that we discovered back in 2009, the hundreds of millions of tons of water ice on the south pole. The water ice represents life support: it is air to breathe, it is water to drink, it is in fact rocket propellant. Hydrogen is the same rocket fuel that will power the Space Launch System and it is the same rocket fuel that has powered the Space Shuttles.

We are going to use the resources of the Moon and then, ultimately, we are going to take all of this knowledge that we learned in this architecture, at the Moon, and we are going to go to Mars. That was all in the President's first space policy directive.

When I became the NASA Administrator, we put together a plan. Given our current budgets, what will it take to achieve this? We came up with a plan, as you identified, that put us on the Moon in 2028, if budgets remain fairly constant.

The challenge that we have as a Nation is that, the longer programs go, the more political risk that we have. When we look back in history, we look back to the 1990s, the Space Exploration Initiative, it took decades in time and it eventually got canceled. We look at the Vision for Space Exploration in the early 2000s; again, it took many, many years and it eventually got canceled.

The question is, how do we reduce risk? There is two types of risk, there is technical risk and then there is political risk. The political risk, it is not partisan, it is just when programs go too long, people start losing confidence and then money gets redirected other places.

Mr. Chairman, I heard you very clearly say slow and methodical, yes. NASA is all about doing things step by step and building on one lesson after another. What we are trying to change as a culture is that word "slow." We don't want to be slow, and I think going fast makes sure that we will have successes. I also think that by going fast, to the Ranking Member's position—we put ourselves in a position to lead the world.

Right now, we have international partners, 15 of them are with us on the International Space Station. We have had astronauts from 19 different countries on the International Space Station. We have had experiments from 103 different countries on the International Space Station. China is moving fast and they are going to the Moon.

The last time they landed on the Moon, they landed on the far side of the Moon, that was in the beginning of this year, they land-

ed with a small probe, and it was the first time in human history anyone had landed on the far side of the Moon. They took out a two-page ad in *The Economist* magazine and made very clear that they are the world's leader in Space Exploration and that everybody in the world should partner with them. Well, I think that is the wrong position.

We have political risk that we need to deal with. It is political risk from programs taking too long; it is political risk from a geopolitical standpoint, making sure that our partners are with us, and not with them. I think those are important reasons to move faster.

We do not want to take any undue risk, we do not want to put any lives at stake, but I can tell you the history of NASA might be a little more slow than what is necessary, and we are changing the organization. As Representative Aderholt said, if we can't land on the Moon within 5 years, we need to change the organization.

I believe that with all my heart and I will tell you why, because in the 1960s President Kennedy announced at my alma mater, Rice University, we are going to land on the Moon before the decade is out. At the time we didn't have the Johnson Space Center, we didn't understand the orbital dynamics of going to the Moon. We didn't have the launch facilities, we didn't have a rocket that could get to the Moon, we didn't have any of these capabilities that we now have to our advantage. They had to go from scratch. They didn't have the miniaturization of electronics, they didn't have the ability to store power in smaller quantities, they didn't have the ability to reuse rockets, and do all of these other things that are on the cusp of changing how we do spaceflight.

If we can't do it today within 5 years, when they did it within 8 years and really 7 years back in the '60s, I think we do need to change how we do things and I think it is important that we go faster.

I heard the Ranking Member say that we need to leverage existing assets. If we go fast and if we want to land on the Moon in 2024, which we want to do, and that is if we wanted to go fast, how fast could we do it? Well, 2024 is how fast we could do it. At the end of the day, I think it is important to note that that is not a guarantee, but it is within the realm of what is possible, and a lot of things have to go right to make that a reality, and what we are asking for in the budget request, is to give us an option to make going fast a possibility.

So I think these are all important things that we need to talk about today and, Mr. Chairman, I appreciate you having this hearing. Ranking Member, I appreciate your comments as well. And I look forward to answering any questions.

[The information follows:]

HOLD FOR RELEASE
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BY WITNESS
October 16, 2019

**Statement of
James F. Bridenstine
Administrator**

before the

**Subcommittee on Commerce, Justice, Science, and Related Agencies
Committee on Appropriations
U. S. House of Representatives**

Chairman Serrano, Ranking Member Aderholt, and Members of the Subcommittee, thank you for the opportunity to appear before you today to discuss the President's amended FY 2020 budget request for NASA and progress on the Artemis campaign. This year we celebrated the 50th anniversary of our first human landing on the Moon, and the President has called once again on this nation to embark on a great voyage of exploration. It is time to prepare Americans to travel to Mars, and the President has directed NASA to return to the Moon by 2024 in pursuit of this goal. This new journey will enable discovery, economic growth, and American global leadership for generations to come. After the Artemis program delivers the first American woman and next American man to the Moon by 2024, we will expand our Mars forward capabilities and efforts, while also establishing a long-term presence on the Moon. This new national mission of returning to the Moon and moving forward to Mars will leave an enduring legacy and inspire the world for generations to come. It will enable a long-term presence and vibrant set of activities on the Moon, in partnership with innovative American companies and our international partners. It will reinvigorate the landscape of American science, manufacturing and technology, as hundreds of thousands of men and women across the nation are employed in working towards this great achievement. NASA is committed to this challenge. To meet the 2024 objectives, we continue to accelerate development of the systems required to ensure initial success, including the Space Launch System (SLS) heavy lift rocket, the Orion crew vehicle, ground systems at Kennedy Space Center (KSC), the lunar Gateway spacecraft, and commercial human lander systems for transiting humans from the Gateway to the lunar surface. To achieve long-term sustainability of the enterprise, we have focused on reducing costs and incentivizing more innovation through different acquisition models to leverage investments to date, as well as increasing competition and partnerships, planning our exploration architecture to partner existing capabilities with advances in the commercial marketplace, and refocusing investment toward technologies that will reduce costs and increase capabilities. Each of these aspects is an integral element in NASA's plans for a sustainable exploration architecture. Now, we are engaged in the safe and rapid acceleration of these plans.

NASA has adopted the name "Artemis" after Apollo's twin sister for the Agency's lunar exploration program and is part of NASA's broader Moon to Mars exploration approach. Through the Artemis program, we will see the first woman and next man step foot on the Moon by 2024, and establish a sustainable architecture with our commercial and international partners on the Moon by 2028. NASA's plans call for one SLS, Orion, and Exploration Ground Systems (EGS) flight per year starting with the Artemis III lunar landing mission in 2024. The actual cadence of missions will be defined based on mission needs, available resources, and operational costs. Reducing production and operations costs will be critical for enabling an ambitious exploration program. The Moon will also be a proving ground where

we will demonstrate technologies and take what we learn on the Moon and enable the next giant leap of human exploration of Mars.

NASA is pressing forward toward the early Artemis missions. Artemis I is an uncrewed test flight of SLS and Orion as an integrated system. This will be followed by Artemis II, a mission that will bring a crew around the Moon aboard SLS and Orion. In 2024, the Artemis III mission will land American astronauts on the South Pole of the Moon. Under NASA's baseline concept of operations, Artemis III will send the first crew to the Gateway in lunar orbit where the crew will transition to a commercial human landing system for transport to and from the lunar surface.

The President's FY 2020 amended budget request for NASA includes an increase of \$1.6 billion above the original request of \$21 billion in funding for NASA. This budget amendment is the necessary down payment required to get us out of the gate to achieve the bold goal of landing American astronauts on the Moon's South Pole by 2024. I am seeking the support of this Committee for the President's FY 2020 amended budget request for NASA so that we can maintain the recent progress we have made and stay on track for 2024. In the absence of full funding of the amended FY 2020 budget request, NASA's plan to leverage existing investments with innovative concepts in U.S. industry through a competitive process that keeps all parties absolutely focused on mission success for 2024 is jeopardized. With the amended FY 2020 budget request, we will invest in America's future, inspire the Artemis generation in science, technology, engineering, and mathematics (STEM) careers, create good paying American jobs, advance science, and lead our commercial and international partners as we move forward with the first woman and next man on the Moon in 2024, a sustainable lunar architecture by 2028, and on to Mars.

Space Launch System

When it launches for the first time, the SLS will be the most powerful rocket in the world and a launch vehicle that supports a new era of exploration beyond Earth's orbit into deep space. Together SLS and Orion are a backbone of the Artemis program. SLS will launch astronauts in the Orion spacecraft on the Artemis missions to the vicinity of the Moon and the Gateway on their way to the surface of the Moon.

SLS capabilities are planned to evolve using a block upgrade approach. SLS Block 1 will have the capability to carry over 70 metric tons to low-Earth orbit (LEO) and nearly 30 metric tons to orbit around the Moon. NASA is focused on the successful completion of the Artemis I uncrewed test flight, the Artemis II first crewed test flight, and the Artemis III mission in 2024 that will enable the return to the Moon. This represents a step-by-step approach to developing the initial SLS capability. Eventually, NASA will follow on with development of the Block 1B capability.

The next evolution of the SLS, Block 1B, incorporates a new upper stage, the Exploration Upper Stage (EUS), now under development, along with updates to associated cargo adaptors. The SLS Block 1B configuration enables co-manifested payloads, increases cargo capability, and enables improved operational flexibility. While upgrading the SLS to the Block 1B configuration remains an important future capability, recent performance issues and delays in SLS core stage manufacturing and design updates related to the Exploration Upper Stage requirements require that NASA concentrate all available resources in the near term on the successful completion of Artemis I, II and III, and supporting a reliable annual SLS and Orion flight cadence thereafter. As a result, we have proposed to defer SLS Block 1B development efforts to later exploration missions. Spending to date on Block 1B (which includes EUS, related flight hardware such as the upper stage adapter, related ground processing capability including the Vehicle Assembly Building (VAB) platforms, and Mobile Launcher (ML)-2) has been consistent with appropriations direction. The development and manufacturing of the first EUS, based on appropriations to date, is included in the existing SLS core stages contract. Future follow-on procurement for EUS

production beyond the current contract, if directed by appropriations, would follow Government procurement practices with respect to consideration of competition.

SLS leverages over a half-century of experience with launch vehicles, including Saturn and Space Shuttle, along with advancements in technology since that time, including model-based engineering, additive manufacturing, high-fidelity computational fluid dynamics capabilities, new composite materials and production techniques, and large-scale self-reaction friction stir welding. Initial flight units use components already procured during the Space Shuttle, such as RS-25 engines and boosters. More efficient methods are under development for manufacturing these components, including new NASA investment in expendable RS-25 engines for the SLS Core Stage with the goal of achieving a lower per-unit cost than the original reusable RS-25s used as the Space Shuttle Main Engines. NASA continues to identify affordability strategies for missions beyond Artemis II. Reducing overall costs of the systems will be critical to achieving a successful and sustainable exploration capability.

During FY 2019, SLS continued to progress towards Artemis I while concurrently building flight hardware for Artemis II, and beginning long-lead procurements and planning for Artemis III:

- Artemis I launch vehicle stage adapter will complete assembly and check out and will ship to KSC in Florida in preparation for integration. The adapter serves as the interface between the SLS Core Stage and the Interim Cryogenic Propulsion Stage (ICPS), the latter of which has already been delivered to KSC.
- Mating of the five Artemis I Core Stage elements (the forward section, oxygen tank, inter-tank, hydrogen tank, and engine section) is now complete. Core Stage engine installation is underway, with the first of the four engines now in position.
- Once both the engine section and RS-25 engines are integrated with the Core Stage for Artemis I, the rocket will be shipped from MAF in New Orleans, LA to Stennis Space Center (SSC) in Bay St. Louis, MS for Green Run testing, scheduled for mid-December of this year.
- Flight software and related avionic components continued testing in the software integration laboratory at Marshall Space Flight Center.
- All of the Artemis I booster components including aft skirt assemblies and forward assemblies are complete and will be delivered to KSC.
- SLS is making strides towards finishing Artemis II flight components including completed Core Stage solid rocket booster segments and significant progress on Core Stage-2, ICPS-2, and other elements.
- Work continued on developing the new RS-25 engines for future missions, achieving a 33 percent cost reduction with innovative and advanced manufacturing methods.

The Artemis I flight will be preceded by a Green Run test campaign scheduled for FY 2020. Planning dates for Green Run test execution are under review. The Green Run test campaign consists of a number of critical engineering tests, including a modal structural test and a cryogenic commodity loading and unloading test, followed by a test fire. For the test fire the liquid Core Stage will be loaded with liquid hydrogen fuel and liquid oxygen oxidizer in the B2 test stand at SSC and all four RS-25 engines will be fired to demonstrate the Core Stage performance prior to launch day. Upon the successful completion of the Green Run test campaign, the Core Stage will ship to KSC and complete vehicle certification.

When all Artemis I SLS hardware is delivered to KSC, the SLS team will effectively hand off all the launch components to the Exploration Ground Systems (EGS) team in Florida and the SLS program team focus will shift to Artemis II and III production for those flights. Fabrication and testing of elements of Artemis II will continue, to include the Core Stage, shipment of the solid rocket booster components, and

additional flight elements. Additionally, the SLS team will continue efforts to restart RS-25 engine manufacturing to support Artemis IV+ missions.

Orion

NASA's Orion spacecraft builds upon more than 50 years of spaceflight research and development. It is uniquely designed to carry astronaut crews to deep space, provide emergency abort capability, sustain crew during space travel, and provide safe reentry at the high-Earth return velocities typically needed to come home from missions beyond low Earth orbit. Orion is capable of supporting a crew of four astronauts for periods of up to 21 days. It is designed to provide communications, navigation, power, and propulsion to carry people and cargo in the harsh environment of deep space and, with a planned mission kit, dock with the Gateway. Through modification and with the support of other new deep space elements, most of the Orion systems could be capable of operations in deep space for periods of time up to 1,000 days. The Orion will also be able to provide key initial life-support and abort capabilities to and from Gateway. Additionally, the Orion systems are designed to operate in a contingency mode to augment life support systems in other space transport systems.

Orion's Crew Module (CM), Spacecraft Adapter (SA), and Launch Abort System (LAS) incorporate numerous technology advancements and innovations. Orion's LAS can activate within milliseconds to carry the crew out of harm's way and position the module for a safe landing. The spacecraft's propulsion, thermal protection, avionics, and life support systems will enable extended duration missions beyond Earth orbit and into deep space. Its modular design will be capable of integrating additional new technical innovations as they become available.

The European Space Agency (ESA) is partnering with NASA to provide the European Service Module (ESM) for Orion. ESA is providing the ESMs to partly offset its International Space Station (ISS) financial obligations. The ESM will provide the Orion spacecraft with propulsion, electrical power, water and thermal control, and maintains the oxygen and nitrogen atmosphere for the crew.

The Orion Program made progress during FY 2019 on both Artemis I and II:

- The Orion Program conducted Propulsion Qualification Module (PQM) firings with active control of the pressurization system on the ESM. This includes the recent successful completion of the most stressful test case, called an Abort to Orbit at White Sands Test Facility near Las Cruces, NM.
- Following the functional tests, the ESM was mated with the Crew Module Adaptor (CMA) to complete the Service Module (SM) assembly. The completed Service Module was joined to the Crew Module, resulting in the combined Crew and Service Module (CSM) earlier this year. This work was performed at KSC and marked the first time all three major elements were integrated.
- The Orion program will ship the integrated Artemis I CSM to Plum Brook Station in Sandusky, OH, for thermal vacuum and electromagnetic interference testing which is a crucial step towards launch readiness. Once completed, the mated CSM will be returned to KSC for final launch processing.
- Continuing the manufacturing efforts for Artemis II, the program completed the Crew Module primary structure and is on track to complete the CMA primary structure at the Operations and Checkout (O&C) Facility at KSC.
- ESM-2 integration has begun in the Bremen, Germany clean room. Long-lead activities, such as welding of high-pressure valves and engine manufacturing, are underway.

- The Ascent Abort-2 test, which successfully demonstrated the ability to safely separate the Crew Module from the SLS during an ascent abort scenario, was carried out at Cape Canaveral from Launch Complex 46 on July 2, 2019.

In preparation for Artemis I, Orion will complete the Orion Structural Test Article (STA) configuration test in Denver, CO, and then ship it to Langley Research Center (LaRC) in Virginia for subsequent water impact testing. This is the last action in the series of tests that will complete the test campaign on the full-scale Orion STA. These tests are conducted to ensure the space-bound vehicle is ready to withstand the pressure and loads it will endure during launch, flight and landing. NASA will also stack and integrate the LAS in the LAS Facility and mate it to the CSM for Artemis I at KSC. After the mating, it will be delivered to the EGS team at KSC for final preparation and stacking in the VAB.

In preparations for Artemis II, Orion will finish outfitting the CM Pressure Vessel at KSC's O&C building. From FY 2020 through early FY 2021, the Orion program will install the Environmental Control and Life Support Systems (ECLSS), the core avionics that provide overall spacecraft command and control, and the heatshield, which protects the vehicle and crew from the extreme temperatures of re-entry. Once installed, Orion will conduct a series of power-on, leak, functional, and proof pressure tests to ensure the health of the CM. In addition, the production of the Artemis II CMA will be completed. To prepare for mating to the ESM-2, the CMA will undergo proof pressure and leak tests followed by subsystem installations, harness testing, and Developmental Flight Instrumentation testing. ESA will complete manufacturing of ESM-2 and deliver it to the KSC O&C facility. Once the ESM-2 is delivered and functional tests are performed, it will be mated to the CMA. After mating, the Artemis II ESM will undergo functional, pressure and leak tests in preparation for integration with the CM-2 planned for crewed flight.

The Orion Program has initiated long lead material purchases for future Artemis missions, which will enable the program to meet an annual flight rate to support lunar exploration. The Orion Production and Operations Contract (OPOC) was signed on September 30, 2019, and includes a commitment to order a minimum of 6 and a maximum of 12 Orion spacecraft, with an ordering period through September 30, 2030. Production and operation of the Orion spacecraft for 6 to 12 missions will establish a core set of capabilities, stabilize the production process, and demonstrate reusability of spacecraft components. Additionally, NASA is working with our European Space Agency partner to establish long-term delivery commitments of the European Service Module to support the Artemis missions. The Orion Program will initiate production activities in FY 2020 for Artemis III, targeted to transport the crew for landing on the Moon in 2024, and will begin the production process to support annual exploration flights. These missions represent United States commitment to – and a core piece of NASA's infrastructure for – deep space exploration. Essential to building a sustainable exploration strategy will be finalizing development and reducing production and operation costs.

Exploration Ground Systems

The EGS team is preparing KSC to process and launch the SLS rocket and Orion spacecraft on Artemis missions. To achieve this transformation, NASA is developing new ground systems while refurbishing and upgrading infrastructure and facilities to meet tomorrow's demands, including those of the Artemis Program. This modernization effort is designed to maintain maximum flexibility in order to also accommodate a multitude of other potential Government and commercial space customers. Drawing on five decades of excellence in spacecraft processing and launch, KSC continues to work toward serving as a multi-user spaceport, as was envisioned post-Space Shuttle retirement.

During FY 2019, EGS has made significant progress:

- The program performed multiple successful launch pad water deluge tests using the Ignition Overpressure Protection and Sound Suppression system at Launch Pad 39B.
- In June, the Mobile Launcher, atop Crawler-Transporter 2, made its final solo trek from the Vehicle Assembly Building (VAB) to Pad 39B at KSC. The Mobile Launcher will remain at the pad over the summer, undergoing final testing and checkouts.
- Conducted several umbilical tests on the Mobile Launcher.
- EGS engineers conducted Underway Recovery Test-7 (URT-7) off the coast of San Diego, CA, using a mock Orion Spacecraft capsule. These tests verify and validate procedures and hardware used to recover the Orion spacecraft after it splashes down in the Pacific Ocean following deep space exploration missions.
- EGS began construction for a new liquid hydrogen sphere for Launch Complex 39B at KSC. The storage facility will hold 1.25 million gallons of the propellant.
- The European Service Module for Artemis I arrived at KSC in November 2018 and underwent a host of tests and integration work before being connected to the Orion crew module.
- EGS continued ground systems development efforts, including efforts for Mobile Launcher structural modifications, installation of ground support equipment necessary to service the rocket and spacecraft, Vehicle Assembly Building High Bay platform work in high bays 3 and 4 necessary to access the over 30-story-tall rocket and spacecraft, and completion of environmental control system upgrades necessary to maintain proper working environment in the massive facility.
- EGS conducted the first formal terminal countdown simulation inside Firing Room 1 in the Launch Control Center at NASA's Kennedy Space Center.
- Consistent with provisions in the FY 2018 Consolidated Appropriations Act (P.L. 115-141), as well as the NASA Administrative Provision in P.L. 115-141 pertaining to the Agency's Operating Plan, NASA awarded a contract in June 2019 to start building the second Mobile Launcher platform. NASA does not have plans to utilize the second Mobile Launcher in the near term, and a final Block 1B design has not been set. NASA is deferring these activities until needed but allowing core design and construction of the platform to continue while awaiting a decision on the upper stage configuration for future missions.

In FY 2020, the EGS Program will complete software development efforts and Multi-Element Verification and Validation of the ground systems to support timely Artemis I rocket and spacecraft processing when the flight elements arrive in CY 2020. Spacecraft processing operations for Orion will take place at the Multi-purpose Payload Processing Facility, followed by SLS flight hardware assembly, SLS/Orion integration, and integrated testing at the VAB to support Artemis I. The program will complete Underway Recovery Tests 8 and 9 to ensure safe recovery of the Orion crew module after the Artemis I mission. EGS will complete ground processing operations in support of an Artemis I integrated launch.

In addition, the EGS Program will continue ground systems development efforts in support of future mission requirements, including the first crewed flight on Artemis II. This includes modifications to the pad and VAB Environmental Control System, upgrades to the Converter Compressor Facility, modifications to the Mobile Launcher to support crew missions, as well as continuation of Liquid Hydrogen Sphere Construction activities at launch pad 39B.

Human Landing System

With Human Landing System (HLS), NASA is employing a capability-driven approach to its human spaceflight strategy by developing a suite of evolving capabilities that provide specific functions to solve exploration challenges. These investments in initial capabilities are to be continuously leveraged and reused, enabling more complex operations over time and exploration of more distant solar system destinations. NASA recognizes the need to foster the development of expertise and technologies required for reusable, sustainable, human-scale landing systems. In addition, NASA understands that investments by the private sector are expected to grow as market opportunities are identified and activities expand from science and exploration to include resource utilization to the benefit of both public and private sectors.

On September 30, 2019, NASA issued the third and final version of the NextSTEP (Next Space Technologies for Exploration Partnerships) Appendix H solicitation for an industry-developed HLS. Two previous drafts generated over 1,150 comments from industry, and based on those comments NASA has made adjustments to streamline the partnering approach and empower industry to meet NASA's functional requirements while meeting the 2024 timeline. NASA is committed to assessing any viable approach that would accelerate a human lunar landing.

Under the FY 2020 budget amendment of \$1.6 billion, NASA intends to select at least three companies by the end of calendar year 2019, with the goal of at least two passing a continuation review in 2020 to take their designs to flight. The first company to complete their lander will be the one to carry the first woman and next man to the Moon in 2024, and the second company will carry the next crew to the lunar surface in 2025.

NASA plans to evolve the initial HLS capability into a sustainable transportation system that will provide frequent access to the lunar surface including both crew and cargo delivery services. NASA further intends for public and private investments in lunar exploration capabilities to eventually expand to include surface elements necessary to support prolonged human exploration to accomplish increasingly advanced exploration goals, including a mission to Mars.

Gateway

NASA has concluded that the Gateway, is key to long-term sustainability on the Moon. The concept has been proposed for decades as a capability that can facilitate a long-term return to the Moon, and can serve as a port for vehicles embarking to Mars. The Gateway provides flexibility and long-term affordability for a repeatable cadence of lunar landings. It also can be used as a site for testing of technologies for critical capabilities on future Mars missions.

Gateway will initially operate in a halo orbit around the Moon – one that is accessible not only by NASA's SLS and Orion spacecraft for crews and outsized cargo, but also by existing rockets on the U.S. domestic market and from our international partners. From this orbit, the Gateway will have a continuous view of Earth, and will be able to support lunar surface telerobotics, including those on the far side. Over its operational lifetime, the Gateway can be transferred to other lunar orbits to increase the potential for demonstrations and scientific investigations, and to expand lander access across the lunar surface.

To accelerate plans to land humans on the surface of the Moon, the Gateway Program has focused development on the initial critical elements required to support Artemis III – the Power and Propulsion Element (PPE), the Habitation and Logistics Outpost (HALO), and logistics delivery services.

Since the March 26, 2019 announcement accelerating the human lunar landing to 2024, NASA has made substantial progress in developing the Gateway, including:

- Awarding of the contract to Maxar Technologies for the development of the PPE.
- Issuing draft (June 14) and final (August 16) RFPs for the Gateway Logistics Services (GLS) contract, which will deliver supplies to Gateway for missions to the lunar surface.
- Release of RFP on September 6, 2019, to Northrup Grumman Innovation Systems for the development and production of HALO.
- Managerial responsibility for developing lunar surface suits under Exploration Extra-Vehicular Activity (xEVA) has been assigned to the Gateway Program. On October 4, 2019, NASA released a Request for Information for the production and services for lunar spacesuits to enable a steady cadence of Artemis missions over the next decade and beyond.

FY 2020 is a critical year for Gateway development. With the awards for HALO and GLS expected to be complete by the second quarter of FY 2020, all initial Gateway elements and services will be on contract. In FY 2020, NASA will also conduct preliminary design reviews for PPE and HALO, and a systems requirements review for GLS. NASA is on schedule to launch the PPE in 2022 and HALO in 2023. Finally, a production award for lunar surface spacesuits is also expected in FY 2020.

Artemis I

Artemis I will be the first integrated test of SLS, Orion, and EGS. The first in a series of increasingly complex missions, Artemis I will be an uncrewed flight test that will provide a foundation for human deep space exploration and demonstrate our commitment and capability to extend human existence to the Moon and beyond. During this flight, the spacecraft will launch on SLS and travel 280,000 miles from Earth, or some 40,000 miles past the far side of the Moon over the course of about a three-week mission before returning to Earth. Orion will stay in space longer than any ship for astronauts has done without docking to a space station and return home faster and hotter than ever before.

The outbound trip to the Moon will take several days, during which time engineers will evaluate the spacecraft's power, propulsion, cooling, communication and navigation systems and, as needed, correct its trajectory. Orion will fly about 62 miles (100 km) above the surface of the Moon and then use the Moon's gravitational force to propel Orion into a distant retrograde orbit, rotating opposite the direction the Moon orbits the Earth, some 40,000 miles (70,000 km) from the Moon. The spacecraft will stay in that orbit for approximately one week to collect data and allow mission controllers to assess the performance of the spacecraft.

For its return trip to Earth, Orion will do another close lunar flyby that takes the spacecraft within about 60 miles of the Moon's surface. The spacecraft will then use another precisely timed engine firing of the ESM in conjunction with the Moon's gravity to accelerate back toward Earth. This precision maneuver will set the spacecraft on its trajectory back toward Earth to enter our planet's atmosphere traveling at 25,000 mph (11 kilometers per second), producing temperatures of approximately 5,000 degrees Fahrenheit (2,760 degrees Celsius) – faster and hotter than Orion experienced during its 2014 flight test – proving the heatshield design is ready to carry astronauts on the next flight test. After about three weeks and a total distance traveled exceeding 1.3 million miles, the mission will end as the spacecraft makes a precision landing in the Pacific Ocean within eyesight of the recovery ship off the coast of California. Following splashdown, Orion will remain powered for a period of time as divers from the U.S. Navy and operations teams from NASA's EGS team approach in small boats from the waiting recovery ship to

perform an initial safety inspection. Orion will then power down to support retrieval of the capsule for post-flight engineering assessment.

Schedule performance by the SLS and Orion Programs is critical to achieving a human return to the Moon by 2024. The preponderance of SLS, Orion, and EGS development and production work is focused on Artemis I, and work is underway to prepare for the first flight of crew on Artemis II. While progress on these programs has been substantial, NASA, its contractors, and international partners have faced challenges with first-time design, assembly, and test. NASA has been working to address these development issues. Earlier this year, the Human Exploration and Operations Mission Directorate (HEOMD) completed an assessment of alternate approaches for hardware processing and facilities utilization for key components with the goal of maintaining an early as possible Artemis I launch date. The NASA Office of the Chief Financial Officer performed a schedule risk assessment of the Artemis I launch date, including the integrated schedule and associated risk factors ahead of Artemis I. NASA plans to establish a new launch date for Artemis I, after replacements are officially named for the previous HEOMD Associate Administrator and ESD Deputy Associate Administrator.

Artemis II

NASA is also moving forward on Artemis II, making progress on the SLS and Orion vehicles that will be used for that mission. Astronauts on their first flight aboard NASA's Orion spacecraft will travel farther into the solar system than humanity has ever traveled before. Their mission will confirm all of the spacecraft's systems operate as designed in the actual environment of deep space with a flight crew aboard. NASA's first Artemis mission with astronauts will mark a significant step forward on NASA's plans to return humans to the Moon for long-term exploration and future missions to worlds beyond, including Mars. The plan for the Artemis II flight is built around a profile called a hybrid free return trajectory. Orion will perform multiple maneuvers to initially raise its orbit around Earth and eventually place the crew on a free return trajectory from the Moon.

After launch, the spacecraft and upper stage of the SLS rocket will first orbit Earth twice to allow enough time for the team to assess the spacecraft's performance, including key life support systems, before committing to proceed with flight around the Moon. Orion will reach a circular orbit at an altitude of 100 nautical miles and last 90 minutes. Following the first orbit, the rocket's ICPS will perform an orbital raise, which will place Orion into a highly elliptical orbit around our planet. This is called the partial translunar injection. This second, larger orbit will take approximately 42 hours with Orion flying in an ellipse between 190 and 60,000 nautical miles above Earth. Once the integrated vehicle completes these two orbits, the ICPS will separate from Orion and the crew will do a unique test of the spacecraft's critical systems. They will gather and evaluate engineering data from the nearly two-day-long Earth orbit before using Orion's SM engine to complete a second and final propulsion move called the translunar injection (TLI) burn. This second burn will put Orion on a path toward the Moon. The TLI will send crew some 3,000 nautical miles past the far side of the Moon where they will ultimately execute a figure-eight-shaped orbit before Orion returns to Earth. Instead of requiring propulsion on the return, the spacecraft will purposefully use the Moon's gravitational pull like a slingshot to bring Orion home, which is the free return portion of the trajectory. Crew will fly thousands of miles beyond the Moon, which is an average of 230,000 miles from the Earth, setting a new record for human distance traveled from Earth. It will take a minimum of ten days to complete the mission.

Artemis III

On March 26, 2019, the Vice President announced at a meeting of the National Space Council in Huntsville, AL, that, at the direction of the President, it is the stated policy of the United States of America to return American astronauts to the Moon within five years and that when American astronauts return to the lunar surface, they will take their first steps on the Moon's South Pole. The Artemis III mission will send the first crew to the lunar surface using a commercially-developed human landing system. With the rapid development of the integrated human landing system and the Gateway, we will have access to more of the Moon than ever before.

NASA is now in the fabrication and assembly phase of developing SLS, Orion, and EGS, and is focused on bringing these capabilities together to conduct the first three Artemis missions. The Agency is incentivizing speed and drawing on commercial and international partners as it looks to land humans on the Moon within five years. NASA is completing development of the Orion spacecraft that will carry humans to lunar orbit, the SLS rocket that will launch Orion, and the Exploration Ground Systems that will support the Artemis missions.

Conclusion

NASA is going forward to the Moon and Mars. With our U.S. industry and international partners, we are returning humanity to our nearest neighbor and building a sustainable, open architecture that will prepare us to establish a long-term human presence on the Moon before embarking on human missions to Mars. We are moving fast; we are incentivizing speed to land humans on the Moon within five years. We are using new acquisition strategies to engage the best of U.S. industry to meet our ambitious goals. We are completing development of SLS, Orion, and EGS. We are pressing forward toward uncrewed and crewed test flights of Orion around the Moon and we are working to land U.S. astronauts on the lunar South Pole by 2024. The lunar Gateway will serve as a reusable command module, supporting repeated human missions to the surface of the Moon, enabling opportunities to access to the entire lunar surface, and supporting human missions to Mars.

A sustainable lunar presence will pay dividends across diverse areas, including American leadership, scientific discovery, technology development, expansion of the economy, and inspiration of the next generation of STEM professionals. We have asked Congress for additional resources to get to the Moon by 2024, which will enable us to get to Mars more quickly and safely. The work we accomplish at the Moon over the next decade and beyond will ensure we can send the first humans to Mars. By focusing on accelerating our near-term efforts to land the first woman and the next man on the Moon in 2024, we will not only begin to realize these benefits sooner, we'll also create momentum that will reduce the political risk of disruptive changes in direction.

Enactment of the President's amended FY 2020 budget request for NASA is required to achieve the Artemis goal of landing the first woman and next man on the Moon's South Pole by 2024. The budget request achieves this goal primarily through commercial development of lunar human landing systems, with full and robust support from NASA; a Gateway configuration aligned with minimally required systems for 2024 landing support for short duration surface missions; and lunar surface suit systems development with initial ground- and ISS-based testing. In addition, the budget request provides for the beginnings of lunar surface and lunar vicinity sustainability, initiating studies on the development of systems that will ultimately be used to put humanity on the surface of Mars. With the Committee's support for the amended FY 2020 budget request, NASA will build upon the recent progress we have made, stay on schedule with our plans for development of the HLS, Gateway, and surface spacesuits;

maintain the sense of urgency that has reinvigorated the NASA workforce; hold the date for the first lunar return mission in 2024; and seize this opportunity to be ready for the first human mission to Mars.

Chairman Serrano and Ranking Member Aderholt, I would be happy to respond to any questions you or the other Members of the Subcommittee may have.

Mr. SERRANO. Thank you.

We will now begin the first round of questions where each member will receive 5 minutes.

The Appropriations Committee has repeatedly asked for information regarding the additional costs of moving the Moon mission up by 4 years. To date, we have received no response. It is hard to justify any extra spending on this effort in the current fiscal year when we don't know the costs down the road.

What is the additional cost associated with moving up the schedule for the next Moon landing by 4 years from 2028 to 2024? And, further, can you please break the cost down by year for the upcoming 5 years?

So let me just tell you on a personal level, although we are here in public—and you know me, we have dealt in the past on a personal level—this is not just about finding the money, it is about where this President is known to go find monies when he needs them. Now, if he came to us and said no wall in return for 2024, you might get a few Democrats to agree with that, right? Maybe more than that. But he is probably going to say lower Pell Grants, lower food stamps, lower education dollars, and that is not acceptable and that is the problem.

But I asked you a question and, I'm sorry, I didn't give you time to answer it.

Mr. BRIDENSTINE. The request for 2020 includes an additional \$1.6 billion. You know, I have been very clear with everybody I have talked to, the goal to get to the Moon needs to be bipartisan; it has to be apolitical. If when we go to the Moon we are doing so by cutting the Science Mission Directorate of NASA, that will create a partisan divide that we do not want to have as an Agency. If we try to take the money from the International Space Station, that will create a parochial fight, maybe with Members from Texas, Florida, or Alabama, about the International Space Station.

Now, those are the two big areas where NASA has money, but I don't think that the right approach is to cannibalize those programs to achieve the Moon landing. I have been very clear with everybody I have talked to on both sides of the aisle, the goal should be additional resources, not cannibalizing one part of NASA to feed another part of NASA.

That being said, when we did the budget amendment, the \$1.6 billion, we were operating under previously established budget caps. I think it is fantastic that an agreement was made between Republicans and Democrats to raise those budget caps, that gives NASA a great chance.

I also want to say, Mr. Chairman, we are grateful for the mark that you did in the House, because you did great work, especially on behalf of the Science Mission Directorate, and that is really good for the Agency. I want to take nothing away from the House mark. It is also true that, when we go forward with trying to get to the Moon in 2024, that requires additional resources.

I understand the concern with the out-years and we want to give you the out-years. We are working right now inside the administration with the Office of Management and Budget, and the National Space Council, to come up with what those out-year numbers are, to get a consensus within the administration about what we are

willing to put forward. Once we have that, we want to give it to you as absolutely soon as possible.

I would also say that the budget submit for 2021 is due in February and certainly we will have it in the 2021 budget submit without question.

If we look at what the Senate has already done, they actually fenced the money pending getting the full report on what the out-years look like, they fenced the 2020 money based on what the out-years look like. I think that is maybe a good solution, something to consider. I think at the end we want to give you those numbers, we are not ready just yet, but certainly we still want to move forward.

Mr. SERRANO. At the expense of beating a subject to death, you were very clear that you don't want to take money from other NASA programs, because you don't want to hurt those programs, I don't want to go to the Moon by taking money from people who can't afford to survive in this society to the level that they should survive in this society. And so that is a big problem that we have to get over, where that money is going to come from.

Your fiscal year 2020 budget justification was delivered to the committee earlier this year and it is still available online. In looking at the outyears budget chart that is included in that budget, what parts of NASA's budget do you anticipate would need to go down during a 2021 through '24 period compared to the numbers displayed on your earlier budget chart in order to pay for the additional costs associated with the schedule change on the Moon landing? What is the cost to other priorities to achieve this effort?

Mr. BRIDENSTINE. My objective is to let everybody know that cannibalizing certain parts of NASA to fund another part of NASA, that is not my goal. Certainly, we are going to need additional resources, and I have been clear that, you know, whether you take it from Station, whether you take it from the Science Mission Directorate, those are the two areas where there is money, when we do that, it creates either parochial fights or partisan fights, and I am trying to maintain NASA's apolitical, bipartisan approach.

I would say that my goal is to not cut any of NASA's budget in order to finance the Moon agenda. The budget submit for 2021 will be delivered in February of next year.

Mr. SERRANO. I am having a little trouble getting my message through, so I will try it one more time and then I will drop it. Okay? You don't want to hurt NASA. Would you please understand that NASA has support from Members of Congress.

Mr. BRIDENSTINE. Yes.

Mr. SERRANO. NASA has support from this committee, as our mark showed, as our bill showed. NASA has the support of the American people, including the very people you would hurt. But would you keep that support if the people knew that eventually it would have to take money from their very-needed situation, you know, a factory worker who needs a little extra from the Federal Government to help feed his family, and now NASA is going to go to the Moon 4 years earlier based on taking money from them. You know, I don't need an answer for that, just to think about that as we go forward.

Mr. BRIDENSTINE. Thank you, sir.

Mr. SERRANO. And my time has been used up. So, Mr. Aderholt, of course.

Mr. ADERHOLT. Thank you.

Regarding the comments you made about SLS production work after your visit to Michoud back—I think it was mid-August that you were there, I was wondering how you think things are currently going for work on the SLS rocket, especially 1 through 3.

Mr. BRIDENSTINE. Absolutely. I will tell you, we have had some very challenging conversations with Boeing, and of course you have seen that in real time maybe in the public. I would also tell you that they have responded in a very positive way to the challenges that we have had with SLS development.

Number 1, we have now started—or in fact we have completed the integration of the engine section. The engine section, which was the holdup, got delayed, and we started integrating the rest of the rocket in the horizontal, which enabled us to integrate the SLS rocket while the engine section was still under development. Previously, if you do the vertical stack, everything has to wait on the engine section. Well, we changed that. We started integrating the horizontal and Boeing did great things in order to make that happen.

The engine section is now complete, the engine section is now integrated into the rocket itself. By the way, we are very satisfied with how fast things are moving now. At this point the engines themselves are being integrated into the engine section, and as soon as that is complete, there will be probably a month or two, maybe a little bit longer, of testing at Michoud. I think by the end of this year we will be moving the SLS rocket out of the Michoud assembly facility and moving it to the Stennis Space Center for testing, for what we call a green-run test.

Boeing has in fact responded very well and we are very pleased with where the SLS is right now.

Mr. ADERHOLT. So you are confident that it will be delivered on time?

Mr. BRIDENSTINE. Well, the new time, yes, sir.

Mr. ADERHOLT. Yes. And of course, as you mentioned, I have heard work that is progressing more quickly—

Mr. BRIDENSTINE. Yes.

Mr. ADERHOLT [continuing]. On the second core, maybe 40 percent faster?

Mr. BRIDENSTINE. A lot, yes. What we learned on the first SLS is paying dividends on the second SLS, so things are moving a lot faster.

I don't know, Ken, do you want to address that?

Mr. BOWERSOX. I would just say that that is true. We are moving faster on the second core, but we are still finding new challenges, right? They are still new rockets and even on the second core I think we might find a new challenge or two, but overall the trend is positive.

Mr. ADERHOLT. But does it seem to you that the work is indeed faster than Core No. 1?

Mr. BRIDENSTINE. Absolutely.

Mr. ADERHOLT. Yeah. No question about that?

Mr. BRIDENSTINE. Without question.

Mr. ADERHOLT. All right. I understand there is growing confidence among the prime contractors for SLS to be able to produce two rockets a year starting in 2024, and they believe they could deliver a Block 1B in 2024. What do you think? Do you think it could be done?

Mr. BRIDENSTINE. It depends what Boeing is willing to invest, quite frankly. We don't have currently the appropriations necessary to achieve that. If we were to do that, we might need some more infrastructure that currently doesn't exist.

Ken, I don't know, do you want to address that?

Mr. BOWERSOX. Well, what I would say is, we haven't seen the performance yet that would indicate that we are guaranteed the second core we would need for a Moon landing in 2024. We are open to considering those types of options, we are looking for that type of progress, but we just haven't seen it yet, sir.

Mr. BRIDENSTINE. To be clear, I am confident that, given our current rate of production, we will have three SLSs available and the third one would be for Artemis III that takes us to the Moon in 2024. I think that is fully within the realm of possibility, but a lot of things have to go right to make that happen. Adding an additional SLS into the mix, I am not confident that that could happen.

Mr. ADERHOLT. All right. Understanding the complexities of integrating the SLS, as both of you do, do you have any reason to believe that the broad agency announcement for the Human Landing System presents a viable opportunity for offerers to engage the prime contractors and forge the necessary agreements in order to incorporate an SLS into the proposals before the response deadline that is in November 1st of this year?

Mr. BRIDENSTINE. Again, this would be a question for Boeing specifically. They would need to look at the SLS and come up with an SLS derivative that would be made available to the offerers for the Human Landing System and then figure out how they would deliver that to those offerers. I think it would require investment from Boeing to do that and the goal would be that those offerers would select Boeing as their provider of that launch service, but it would be a launch service.

I think it is in the realm of what is possible, if Boeing wanted to make those investments.

Mr. ADERHOLT. Do you want to comment on that?

Mr. BOWERSOX. I would just concur with the Administrator.

Mr. ADERHOLT. Okay. All right. Thank you, Mr. Chairman.

Mr. SERRANO. Thank you.

Let me recognize our Ranking Member, Ms. Granger.

Ms. GRANGER. Thank you.

Administrator Bridenstine, could you pretty succinctly—to me, there are three questions. One is, why should we accelerate this at the cost it is? What is the primary importance of that change and whether it is worth that very large investment? And then focus on the sensitivity of the national security and say what does it mean to taxpayers. So we are talking about how you pay and what it costs. Talk to us about that and say then, then how does that benefit our taxpayers?

Mr. BRIDENSTINE. Oh, it is huge. This, I think, goes to what the chairman was talking about earlier about the tradeoffs.

We look back at Apollo, and we just celebrated 50 years of Apollo, everybody in America loved it. We saw 500,000 people on the National Mall celebrating 50 years of Apollo. I know all of us, we have seen 500,000 people on the National Mall before, we have never seen 500,000 happy people celebrating something good. [Laughter.]

Mr. BRIDENSTINE. That was a very, very great day for NASA, it is a great day for America, and it is 50 years later. The inspiration that came from that moment in time was transformational for our Nation and transformational for people that, you know, went into the STEM fields that otherwise never would have done that. You walk around NASA and you ask folks, hey, why are you here? They will tell you where they were when Neil Armstrong and Buzz Aldrin walked on the Moon, and I'm sure the people that are of age on this committee could probably tell me where they were on that day as well.

I will tell you, the sad thing is—and this is why we need to go faster—I am the first NASA Administrator from that day to this day that was not alive when that happened. I think that is a big challenge. The reality is, I don't have that memory, and we have got to make sure that we don't have another generation that goes by that doesn't have that memory. When it happens, we need to make sure that it is the United States of America leading a coalition of Nations that makes it happen.

Going to your question about what is the value to the taxpayer, all of that I think is tremendously valuable to the taxpayer. It was a piece of ultimately winning the Cold War; I am not going to say it was the preponderance of it, but it was a piece of it.

Now, all that being said, remember, some people will be watching this—I know on TV, some people watching, are going to watch on Dish Network or DirecTV, maybe they have Internet broadband from space. I come from Oklahoma, rural Oklahoma, if you don't have broadband from space, you don't have broadband. Communication, navigation, GPS technology, born from this little Agency called NASA.

The way we do disaster relief, national security, and defense, all of these capabilities—I should say, a lot of these capabilities born from a little Agency called NASA. The way we predict weather, weather satellites are purchased by NASA, and of course the program management of those weather satellites is NASA. How we understand climate and how it is changing is done by NASA. The way we produce food, we are increasing crop fields, decreasing water usage, and preserving nitrates in the soil. All of these technologies come from NASA. The way we produce energy and do it cleanly without greenhouse gas emissions. Methane leaks, those kind of things, we can detect it from space instantaneously, help the oil companies prevent getting fined from the EPA.

These are things that are transforming how the world moves forward and these technologies and capabilities have elevated the human condition for all of humanity in ways that, if you asked Neil Armstrong and Buzz Aldrin, why are you going to the Moon, they wouldn't have said any of that, because they wouldn't have known, but now we know. The return on investment, we are less than half of a percent of the federal budget, and you look at what we have

been able to deliver by creating technologies and capabilities that get commercialized, that elevate the human condition, I think the return on investment is just outstanding.

Ms. GRANGER. Thank you.

Mr. BRIDENSTINE. Thank you.

Mr. SERRANO. Thank you. You are not scoring any points by reminding people that you are younger than some of us. [Laughter.]

Mr. Cartwright.

Mr. CARTWRIGHT. Thank you, Mr. Chairman.

And thank you, Messrs. Bridenstine and Bowersox, for being here. I don't think it is any secret that as a member of the NASA and Planetary Caucuses, I share your enthusiasm for NASA, and I believe in your mission and I support your people, and I am willing to bet that everybody on this subcommittee feels the same way.

Mr. BRIDENSTINE. Thank you, sir.

Mr. CARTWRIGHT. We are appropriators and we have to deal with the dollars and cents.

Mr. BRIDENSTINE. Yes.

Mr. CARTWRIGHT. And we have to evaluate budget requests. And I appreciate your comments about not cannibalizing one part of NASA for another, but the fiscal year 2020 NASA budget requested an overall reduction of \$480 million, including a reduction in the science budget of \$600 million and the complete zeroing out of the Office of STEM Engagement. You submitted that, didn't you, Administrator?

Mr. BRIDENSTINE. Yes, that was in the budget submit.

Mr. CARTWRIGHT. So we have to drill down on this stuff. This subcommittee rejected those cuts for fiscal year 2020, just as we did in fiscal year 2018 and 2019. We increased NASA's funding by \$815 million, which fully funded the lunar landing program and robustly funded scientific discovery and STEM education. If you are detecting a pattern there, you are right.

Look, the 2020 NASA budget request evidently did not adequately fund Artemis, because a mere 2 months later you submitted this \$1.6 billion supplemental request for increased Artemis funding. And what I am trying to do is I am grappling with the true cost of the program and whether NASA has a firm grasp on it, how much money you need for Artemis and when you are going to need it.

So the first question is, at what point did you realize that the fiscal year 2020 budget request was insufficient to fund the Artemis program?

Mr. BRIDENSTINE. Well, I would say for that budget request there wasn't an Artemis program at the time. We put together a budget to land on the Moon at the earliest possible date without any changes to the budget or with, you know, changes to the budget based on inflation. At the end, we were able to say—and it was a stretch, but we could say we could land on the Moon in 2028. And—

Mr. CARTWRIGHT. I don't mean to interrupt you—

Mr. BRIDENSTINE. Yes.

Mr. CARTWRIGHT [continuing]. But the question is asking, when did you realize that the 2020 budget was going to be insufficient for the Artemis program?

Mr. BRIDENSTINE. After the 2028 date came out, there were a lot of people that said that is too long. The challenge is, when these programs last a decade, there is risk from a budgetary perspective.

Mr. CARTWRIGHT. Okay, I think I am with you. So it was after the acceleration of the program—

Mr. BRIDENSTINE. That's right.

Mr. CARTWRIGHT [continuing]. That you realized you didn't have enough money, that makes sense. And so you didn't know—before submitting the fiscal year 2020 budget request, you didn't know about that acceleration; fair?

Mr. BRIDENSTINE. We had not planned to accelerate at that point.

Mr. CARTWRIGHT. All right. Now, you have described the \$1.6 billion supplemental request as a down payment and here is what we are kind of grappling with, Administrator: what is the total cost of the whole program? I mean, you go to buy a car and there is a car salesman standing there, and what do you ask him? You ask him how much is the car.

Mr. BRIDENSTINE. Right.

Mr. CARTWRIGHT. And when he comes up to you and he says, well, it is only going to be \$2,000 in the first year. And you say, yeah, but I am asking you how much the car is. And he says, what do you mean? I mean, after the first year, how much do I have to pay for this car? And he says, oh, no, those are the out-years. And, you know, that is not acceptable. You need to know the total cost. And you have said, I think in response to the chairman's question, you don't have those figures.

Mr. BRIDENSTINE. Well, we are working through with the Office of Management and Budget, and the National Space Council, to come up with an administration consensus for what the total cost will be, and we will submit that in February.

Mr. CARTWRIGHT. February of this coming year, you are going to have those figures for us?

Mr. BRIDENSTINE. It will be part of the budget submit in February, yes, sir.

Mr. CARTWRIGHT. Okay. And do you know sitting there today how much extra the whole project is going to cost because of accelerating it?

Mr. BRIDENSTINE. There are a lot of different options that would be available. Some of the options increase the probability of success, some of the options decrease the probability of success, and based on the range of options—and these are what we are looking at as an agency and working with the Office of Management and Budget attempting to come to a resolution on—for example, you know, I really believe it would be in the interest of success to start off with at least three different human landing systems that we could then down-select to two human landing systems. We have dissimilar redundancy and that gives us a higher probability of success.

If the budget constraints put us in a position where we can only have one human landing system, we put ourselves in a position where a contractor could have pricing power that could get us in a position where we have cost overruns and schedule delays. I don't know that that is in the best interest of the agency, it is not in the

best interest of success. But here is what we know: we know that more money early reduces costs, but if we go inexpensive early then the likelihood is that cost goes up over time.

These are all different trades that we are looking at at this point for the out-years that we are anxiously anticipating delivering in February.

Mr. CARTWRIGHT. All right. Finally, Science Committee Chairwoman Eddie Bernice Johnson raised an issue regarding the specific appropriations language included with the \$1.6 billion supplemental request and I want to follow up with you on that point. Is it your understanding that the language in the supplemental request would allow NASA to transfer funds from other agency accounts to pay for Artemis?

Mr. BRIDENSTINE. That is not the intent. The intent is to have as much flexibility as possible within Artemis. There are some things that go fast and some things where we find what we don't know. There are unknown unknowns that we have to be prepared for and that flexibility gives us that.

I have heard people having concern that we are going to take money from the Science Mission Directorate to fund Human Exploration and Operations; that is not my intent, nobody I have talked to at NASA indicates that that is anybody's intent.

Mr. CARTWRIGHT. And specifically, I am going to quote her, she said "the language would give you carte blanche authority to move funds among NASA's accounts from this year forward if you determine that transfers are necessary in support of the establishment of the U.S. strategic presence on the Moon," unquote, and you are saying that is not so?

Mr. BRIDENSTINE. Look, this has to be bipartisan and I think, if we put ourselves in a position where, you know, one side of the aisle is not happy with what we are trying to achieve, we will not be successful. We want to make sure this is apolitical and bipartisan as much as possible. I think, again, cannibalizing the Science Mission Directorate to achieve the objectives of Human Exploration—which, by the way, I don't think they are exclusive of each other—that narrative gets promoted a lot, but I don't think they are exclusive. I think they work hand-in-hand—I think it is within the realm of we don't have any desire to do that—

Mr. CARTWRIGHT. All right.

Mr. BRIDENSTINE [continuing]. We want to make sure that we have the support of both sides of the aisle.

Mr. CARTWRIGHT. So no cannibalism in the February figures?

Mr. BRIDENSTINE. Right.

Mr. CARTWRIGHT. Thank you.

Mr. BRIDENSTINE. Agreed, we agree on that.

Mr. CARTWRIGHT. I yield back, Mr. Chairman.

Mr. SERRANO. Mr. Palazzo.

Mr. PALAZZO. Thank you, Mr. Chairman. And thank you, Administrator Bridenstine and Associate Administrator Bowersox, for being here today. I really appreciate it.

Under NASA, the American space program has been a symbol of world leadership and national pride. At this crucial point in our history, we must use our investments wisely and work even harder

to advance sound policy if we expect to maintain American leadership in the space domain.

To help NASA centers across the country engage with commercial industry and become better stewards of their under-utilized infrastructure, we have introduced H.R. 4304, the NASA Enhanced Use Lease Authorization Act of 2019. This bill will reauthorize NASA's EUL agreement authority for 10 years and is supported by Representatives from both sides of the—of both parties, and across the country, from Virginia to California and everywhere in between.

Administrator, can you elaborate on the ways NASA centers across the country have successfully used EUL agreements to reduce operating costs and improve NASA facility conditions?

Mr. BRIDENSTINE. Absolutely. I think there are some really good examples of infrastructure that would include buildings, for example, where a private company wants to use a building that NASA is not using currently, and part of the way they have access to that building is to make it usable and improve it. Then, after a period of time, NASA has the rights to that building again in the future, or they could continue their lease.

These are all good things where NASA can partner with the private sector. We have similar kind of agreements for launch facilities and of course, as you are familiar with at Stennis, test facilities. I think there is lots of opportunity to improve NASA's facilities by partnering with the private sector.

Ken, do you have anything to add to that?

Mr. BOWERSOX. Well, I think you have hit a couple of those. The launch pads at the Cape, there are lots of production facilities and operations facilities at the Cape where we are using those types of agreements. At just about every center where we have got spare capacity, we are trying to find users from outside NASA who can come in and take advantage of those facilities. It has been really helpful to us.

Mr. PALAZZO. Not reauthorizing EUL, what would happen?

Mr. BRIDENSTINE. It would be really bad for NASA. It would be really bad for our private sector partners. Please, reauthorize it.

Mr. PALAZZO. Well, great. And that please also to my colleagues on this committee. If you haven't signed onto H.R. 4304, I know Ms. Kaptur and I would appreciate it if you would take a hard look at it and we will get it to you.

So another question is, you know, I am proud to represent Stennis Space Center, where NASA has tested every rocket since the Apollo program. And, as I am sure you know, the SLS core stage is scheduled to ship from Michoud to Stennis this December for the green-run engine test. We are encouraged by the progress on SLS this year as we near the completion of the first flight rocket for Artemis I, and continue to see the rocket for Artemis II being built.

Given your rationale for SLS undergoing the green-run test and the plan to conduct a similar green-run test on the exploration upper stage at Stennis, do you believe the lunar lander provider should also conduct a similar green-run engine test as part of the development program? And, if not, what is the rationale for not putting the landers through the same thorough and rigorous testing as the SLS core stage and the EUS at Stennis?

Mr. BRIDENSTINE. I will start and then I am sure Ken will have some thoughts on this as well, because he is an astronaut that has had the experience of riding on these kind of vehicles.

I think it is important that we recognize that what the commercial providers ultimately provide, a lot of it could have already been tested. We are not saying how to land on the Moon, we are asking them to propose to us how they would do it and if to go from the Gateway, which is that space station in orbit around the Moon, to get to the surface of the Moon and back to the Gateway, if to do that we are using hardware that has been tested significantly, you know, a transfer vehicle, an descent module, an ascent module, you know, when you talk about propulsion, there could be solutions that have a lot of history that we wouldn't necessarily need to green-run test. However, there could be brand new designs with brand new capabilities that might be necessary.

I don't want to prejudge what NASA is going to require, but certainly depending on the solutions that we get presented, we will have, of course, thoughts on it.

Ken.

Mr. BOWERSOX. Yes. All I will say is, we are going to very carefully look at all the test plans that we get back from the human landing system providers once the proposals are all in. To talk a whole lot more in detail wouldn't be good right now, since we are in blackout for the proposals. Depending on the type of engines they have, Stennis might be a great place for testing, but other types of engines we have done at different places in NASA and companies have done at other places around the country, but they will be thoroughly tested before they get to the Moon.

Mr. PALAZZO. Thank you for your responses.

I yield back.

Mr. SERRANO. Mr. Case.

Mr. CASE. Thank you.

The overall purpose of the hearing is to discuss with you whether the big picture, long-term fiscal and operational considerations have been thought through, were thought through when we got a pretty sudden and unexpected request for a supplemental appropriation. So it is one thing to deal with a supplemental appropriation, it is another thing to deal with kind of the implications of it over the long term. And you have commented in response to the chair's question that you would be submitting with the fiscal year 2021 budget a long-term out-year projection for this particular proposal; correct?

Mr. BRIDENSTINE. Yes, sir.

Mr. CASE. And does that submission include an updated, full life cycle mission cost assuming a '24 mission?

Mr. BRIDENSTINE. Yes.

Mr. CASE. Okay. Does it include—you are proposing to outsource, essentially, a lot of this work; right? So you are going to have a whole bunch of development partners out in the private sector on fixed-contract situations, that is your intent; right?

Mr. BRIDENSTINE. Yes.

Mr. CASE. Okay. That is going to take a lot of internal supervision, because that is a lot of money running wild out there and,

if not adequately overseen, it could easily get away from you, budgetary-wise as well as, I would suspect, quality-wise.

So do you anticipate that in your recalculation of an accelerated mission, you would beef up your oversight capabilities inside NASA?

Mr. BRIDENSTINE. Well, I think we have pretty good oversight capabilities already. What we are doing is we are applying the lessons of the past.

If you look at how we resupply the International Space Station right now, we do it with what we call commercial resupply. What that means is NASA doesn't purchase, own, and operate the hardware; we buy a service from a robust commercial marketplace. That robust commercial marketplace was in fact developed by NASA with our investments where we invest our money, our commercial providers invest their money. We started off with three different providers, we down-selected to two, but now they are competing against each other on cost and innovation, which does drive down cost, it makes sure that we are continuing to innovate to drive down cost, and the goal is to create a competitive environment. Because we did commercial resupply that way, the cost savings have been significant. We are on the cusp of having success with commercial crew as well.

The interesting thing is, when we do programs in this fashion, the contractors don't come back to NASA and ask for more money all the time. In fact, they both want to be first. Our engineers are embedded with their engineers, our, you know, finance folks are working with their finance folks, our development and the fixed price that you mentioned before, that fixed price has milestone payments associated with it, we are controlling the process all along the way.

But the goal here is to have as much as possible we want NASA to be a customer of services, especially for low-Earth orbit, and then ultimately not just a customer, but also have providers, numerous providers that compete against each other.

Now, that is how we are doing the low-Earth orbit activities, but we need to go to the Moon. To get to the Moon on schedule, we are going to need to use the SLS rocket, and that is going to be a great program going forward for long periods of time.

Mr. CASE. Okay. Let me—

Mr. BRIDENSTINE. Different—it is a mix.

Mr. CASE. I got it. So I would suggest to you that is a concern of mine, at least—

Mr. BRIDENSTINE. Yes, sir.

Mr. CASE [continuing]. That you be able to watch big, accelerated contracts.

And then, number two, do you anticipate that a corollary of your proposal to accelerate would also be an acceleration of a Mars mission, is that sequential? In other words, is that a big picture, long-term consideration that this committee should know about? Because if it may not only be about the Moon that you are asking an accelerated program for and I don't think we would want to be surprised on that one. We would want to know what the big picture, long-term plan is for the overall deep space exploration.

Mr. BRIDENSTINE. Yes, sir. Congressman Case, you are hitting the nail on the head, which is the sooner we get to the Moon with an architecture that is sustainable, we need to learn how to live and work on another world, that is what enables us to go to Mars. When we go to Mars, we have to be there for a long period of time. We have to use the Moon as the proving ground so we can get to Mars.

If we delay the Moon program, by definition we are delaying the Mars program. If we accelerate the Moon program, we are by definition accelerating the Mars program. That is a great question and a good point.

Mr. CASE. Thank you. I hope we get that information in the context of fiscal year 2021 as well.

Mr. BRIDENSTINE. Yes, sir. We will make sure—we will have strong Mars content in the budget request.

Mr. CASE. Thank you.

Mr. SERRANO. Ms. Meng.

Ms. MENG. Thank you, Administrator Bridenstine and Associate Administrator Bowersox, for being here today.

Administrator Bridenstine, earlier this year when you were here you testified about what NASA is doing to increase opportunities for women in STEM careers at the agency. I wanted to circle back to something specific you said in your comments about spacesuits and the then-canceled all-female space walk. You said, quote, “It should be noted that the spacesuits are in essence little spaceships. Each one of them is designed specifically not just for the astronaut, but also for the mission. The challenge is, we only have a certain number of spacesuits,” end quote.

You also stated publicly at a Senate Commerce hearing that NASA is looking at a spacesuit architecture that is flexible to allow astronauts to conduct missions in low-Earth orbit and the Moon.

With yesterday’s announcement of NASA’s two new spacesuit designs for Artemis, I wanted to ask a few questions. One, do we know how many years did NASA need to research and develop spacesuits that Neil Armstrong and Buzz Aldrin used?

Mr. BRIDENSTINE. Oh, that is a good question. I honestly don’t know, but I will be happy to make sure I get that back to you. The question is, how long did it take to develop the original Moon-walking spacesuits. We will look that up.

Ms. MENG. Thank you.

What lessons did NASA learn from the canceled all-female space walk at the International Space Station that might help with the research and development of the next generation spacesuit?

Mr. BRIDENSTINE. I think we had already learned the lessons. It kind of made it very transparent that spacesuits are very difficult, because they are so large, and we need spacesuits. The history of NASA is to build a spacesuit that works and then try to downscale it and, when we do that, it is a lot harder than starting small and then upscaling it for larger people. We need a spacesuit that can go from the 1 percent to the 99 percent in size.

I think we have already been investing, as you saw it yesterday with the announcement, in making that possible, not just for space flight, but also for walking on the surface of the Moon; we are very committed to it, we have been committed to it for a long time. The

space walk that you referenced obviously highlighted why we have been committed to it.

I know Ken probably has something to say on the spacesuits.

Mr. BOWERSOX. Well, I was just going to say that on the way here this morning, I got to check the TVs in our ops center there at NASA headquarters, and I saw the two women on orbit right now preparing their spacesuits to go outside, and that was really exciting for me to see, you know, and we hope to see that EVA really soon.

Part of the problem we had last time was, you know, we were resizing the suits for the spacewalkers who are going to go out on this EVA, but the suits at that time needed even more work than what we are doing for this particular EVA. That was part of our issue.

Mr. BRIDENSTINE. We are doing the all-woman space walk here in a matter of days. We are very excited about it.

Ms. MENG. What challenges and maybe key milestones must be met with a 2024 time line to bring astronauts to the Moon—research, testing, deployment?

Mr. BRIDENSTINE. Right. The SLS rocket, the biggest, most powerful ever built that will take our astronauts to the Moon, is at Michoud. It is going to come out of the facility here by the end of the year and go to Stennis to get green-run tested. The Orion crew capsule and the European service module are complete, they will be testing soon up at the Glenn Research Center in Ohio. All of that is positive.

The challenges that we have right now, we have to start with a human landing system. You can't land on the Moon if you don't have a landing system. That is one of the reasons why we did the amended budget request. We are underway with the development of Gateway, which is a small space station that will be in orbit around the Moon for 15 years. Think of it as a reusable command module, just like Apollo, except it doesn't get thrown away at the end of the mission. It is going to be used over and over again by multiple missions over the course of 15 years and probably longer. The spacesuits, of course, are a big piece of the architecture as well.

The SLS rocket, the Orion crew capsule, the European service module, the Gateway, and the human landing system and the spacesuits. Now, at the same time, we are doing commercial crew, which will be launching in the first part of next year to low-Earth orbit.

Just know this, Congresswoman, as an Agency, we have more under development now than at any point in NASA's history and these are big programs. We are working really hard right now to make all this a reality and we are confident with where we are. Especially when it comes to commercial crew, we are confident; SLS and Orion, we are confident. Gateway and the human landing system have some outstanding issues, just because they are so early in the development process.

Ken, did you want to add to that?

Mr. BOWERSOX. The only thing I would just emphasize is that our biggest technical challenge is getting the landers ready for

2024, that is the most challenging part of what we have got to develop, and we are excited to take on that challenge.

Ms. MENG. Thank you. I yield back.

Mr. BRIDENSTINE. Thank you.

Mr. SERRANO. Ms. Kaptur.

Ms. KAPTUR. Thank you, Mr. Chairman.

And welcome—

Mr. BRIDENSTINE. Thank you.

Ms. KAPTUR [continuing]. Administrator. We are really glad to have you here this morning and I know how hard you work at your job.

Mr. BRIDENSTINE. Thank you.

Ms. KAPTUR. And also, Mr. Bowersox, thank you so very much for your service to our country.

I wondered if we could just step back a second from the budget request directly and I wanted to ask you about the timetable, the change in timetable, and how the date, the accelerated date of 2024 was chosen.

And then if you could provide for the record, if you haven't already done it, the original timeline, the budget proposal for that, and then the accelerated timeline and the budget proposal for that. I think it would be very helpful to us.

And it is quite—I mean, it is a significant change, and one of my questions for the American people is, though we support you in your efforts to land on the Moon and Mars, I go back to a report that Norm Augustine did many, many years ago where he said unmanned flight could provide us with a great deal of research, data, and space results, whether it is commodities or whatever, than human space flight. When you add humans into the mix, it becomes much more expensive.

I am wondering whether you have read that report and whether you believe that to be outdated. And my primary question is, how was the date of 2024 chosen, as a starter here.

Mr. BRIDENSTINE. Great question. There are two things with the 2024 date. A number of things changed.

Number one, when we came out with the date of 2028, that was based on, you know, budgets not changing significantly, within inflation. There were people, people in Congress, members of the administration, that said 2028, that is 10 years, and programs that last 10 years, obviously, they get cut. Historically, that has been the history of NASA, going back to the Space Exploration Initiative in the 1990s, the Vision for Space Exploration in the early 2000s, and here we are and this is going to be Lucy and the football again. How do we retire as much risk as possible to ensure success? And the answer was, well, we need to go faster.

If we are going to go faster, then the next question was, where do we get the money? Do we cut Science? Do we cut Station? My response was, neither, we need to get new money, because those will create political or parochial divides between Members of Congress that we don't want to create.

We got an additional appropriation—or a request for appropriation of \$1.6 billion and that accelerated the timeline. It is not just the risk of these long programs, there are also some other changes that have happened. China landed on the far side of the Moon for

the first time in human history. They are going to be landing on the Moon, according to them, they are going to be landing humans on the Moon in 2030. When they landed on the far side of the Moon, they took out a two-page spread in *The Economist* magazine saying that they were the world's leader in space exploration and all the countries and nations need to partner with them. They are building a space station, all of these things.

The question is, do we want to lead the world in space or do we want to yield that to somebody else? The decision, I think, or the appropriate decision is to maintain the leadership and keep our partnerships.

Ms. KAPTUR. As you look forward, what are the—and I would ask you for the chart, 2028 versus 2024 and the appropriated dollars that are necessary in both scenarios.

Mr. BRIDENSTINE. Yes.

Ms. KAPTUR. Could you pinpoint a few of the most difficult technologies or systems that require concerted effort to achieve the objective?

And, in achieving those, has NASA a deep experience in working, for example, on the energy technologies with the Department of Energy, let's say, and some of their labs? Could you discuss a little bit about ways in which other parts of the Federal Government might help you achieve your objective if it isn't directly in your budget, let's say?

Mr. BRIDENSTINE. Absolutely. This goes to your first question about robotic science versus human exploration. In fact, we do partner with the Department of Energy on a lot of our robotic missions, because they use nuclear power, what we call radioisotope thermal generation, which ultimately powers our spacecraft when they go to Pluto. At Pluto, you know, solar energy is just not that robust at Pluto.

When we go into deep space, we have to have different ways of getting propulsion. Radioisotope thermal generation is a form of nuclear and it is the only way we can do deep space exploration, so we work with the Department of Energy on those types of activities.

When we send humans to Mars, it would be in the best interest of our Nation to use not radioisotope thermal generation, but in fact nuclear thermal propulsion, which would be an absolute game changer for how we do deep space exploration.

I would also argue—and this would be, something for maybe the Armed Services Committee, that the Department of Defense (DOD) should have a significant interest in that capability for propulsion as well. I would imagine there would be some bleed-over or crossover there from a capabilities perspective.

I think when it comes to communications technology, I think there is a lot of opportunity there. When we talk about super-heavy lift and the SLS rocket, I think that that could have a lot of applications for national security capability as well.

I think there is a lot of crossover. These are things that we think about. It is one of the reasons the National Space Council was established, we can think cross-agency about how we do these kinds of programs.

Ken, did you want to add anything?

Mr. BOWERSOX. Just about everything we do in human space flight crosses over to what is being done say in the DOD. You know, I was assigned to NASA as a military astronaut, and that is part of the reason we do that is there is a lot of crossover. But the intent at NASA is peaceful use of outer space, right? To be able to use these technologies to build relationships with partners around the world.

If you look at future exploration activities, the areas where we could probably cooperate the most are in the areas of nuclear propulsion and nuclear power for the surface, those would be game changers for exploration.

Ms. KAPTUR. Would you classify those as—for the record then, Mr. Chairman, could I just ask a listing of the most difficult technologies and systems that you face in achieving success in this project?

Mr. BRIDENSTINE. Sure.

Ms. KAPTUR. Thank you.

Mr. SERRANO. Mr. Crist.

Mr. CRIST. Thank you, Mr. Chairman.

And thank you, Administrator Bridenstine and Mr. Bowersox, for being here today. We appreciate your presence and your service to our country.

As a Floridian, space exploration both interests and excites me. It is part of our state's culture and our economy. I have companies and constituents in my district who are working diligently to develop and build SLS, Orion, EGS.

But, perhaps most importantly, human space flight can inspire our Nation, as we all know, and you talked about it earlier, Administrator, and help motivate future scientists and explorers.

As you both I know are aware, supporting the goal of sending the first woman and next man to the surface of the Moon is a priority for all of us, as long as it is done safely and efficiently. Failure is not an option when pursuing an endeavor of this magnitude, because if we do fail it could threaten our ability to ever return to the Moon again. So we have to get it right, I am sure we all agree.

I want to help NASA meet its goal of 2024, but I need to see a schedule and cost estimate to understand how best for us to do that.

So, Mr. Administrator, with that, you have previously indicated that a full schedule for Artemis is being deferred until a new Associate Administrator for Human Exploration is in place, but it seems to me that NASA should be starting to put that schedule together now, so it can be provided to new leadership as soon as they take over in order to hit the ground running. So can you discuss what work, if any, NASA has been doing thus far to put together a schedule with analysis with respect to Artemis, particularly Artemis III?

Mr. BRIDENSTINE. Yes, sir. I think regarding having a new Associate Administrator for Human Exploration and Operations, what I wanted to make sure we didn't do is set a schedule for launching the SLS rocket specifically and set a schedule for launching commercial crew specifically until a new Associate Administrator for Human Exploration and Operations has had an opportunity to assess—because, again, accountability matters and, if I set the sched-

ule and then they come in later, it might not be a good dynamic for accountability.

That being said, this morning we announced that we will have a new Associate Administrator for Human Exploration and Operations, Doug Loverro, who I have known for many years. He testified before the committees when I was in the House of Representatives that I served on. I was on the Armed Services Committee Strategic Forces Subcommittee, Science Committee Subcommittee on Space. He is somebody who has worked in the space environment for a very long time, very successfully, with program management.

That being said, our goal is to get you all of those things that you need in February. In February, we are going to do the budget submit for 2021 and we will have a run-out for all of the out-years in that 2021 budget submit.

It is also true that if you look at what the Senate has already passed in their committee, they actually fenced the 2020 numbers pending that submission in February 2021. So, I mean, I think that could be a solution for how to go about making sure that we are all in agreement on how to move forward and at the same time not moving forward without being in agreement on how to move forward.

Mr. CRIST. So you think that would be available by February of next year?

Mr. BRIDENSTINE. Yes, February, this coming February.

Mr. CRIST. This coming, yes. And that would include the cost estimate for Artemis III?

Mr. BRIDENSTINE. Yes.

Mr. CRIST. Okay. In addition to the schedule and budget, what other decisions or actions related to Artemis are on hold or otherwise may be impacted by the leadership uncertainty until it was announced this morning?

Mr. BRIDENSTINE. I think the big thing is, we have great program managers for every element of what is required to go to the Moon and eventually on to Mars. And of course Ken Bowersox has been the Acting Associate Administrator and he has done just an amazing job. Of course, having an astronaut who is an engineer who has worked in the private sector—by the way, a Navy astronaut—for a Navy guy, we like that. He has been doing—I see Palazzo laughing at me—we had this conversation when I was in the House. But Ken has done a wonderful job. I am looking forward to getting Doug Loverro on board and having him and Ken work together to achieve all of the great things we have established.

Mr. CRIST. Thank you, Mr. Administrator.

Thank you, Mr. Chairman.

Mr. SERRANO. Mr. Administrator, part of the issue that I keep coming back to is the importance of knowing the full cost. We are appropriators. I won't be here after next year, but, you know, we always say about what we leave our children, I also am concerned about what I leave other appropriators after I leave. And if we find—or gut programs to find the over \$1 billion when we are buying into the 2024 date and we don't know how much it is going to cost down the line.

So I implore you, as you try to gather support from both sides of the aisle, to understand that, unless we know what this is going to cost at the end, it would be irresponsible for us to take the first step. And certainly for me—and this is not about me or about him or about the other one—I certainly don't want to leave these folks after I leave this year, and Mrs. Lowey leaves at the same time, with having to figure out how to pay the other \$25 billion over a period of time. And so we need to hear from that you and we don't hear it and we don't see it.

Now you spoke about February having those numbers. February may seem early in the year, but February, these guys behind me, these folks behind me are already working on numbers for what the budgets will look like and so we need to know earlier, much earlier. Okay?

Mr. Administrator, as you know, the Aerospace Safety Advisory Panel evaluates NASA safety performance and advises the agency on ways to improve that performance. Since the March 2019 announcement of the 2024 landing goal, has the Aerospace Safety Advisory Panel weighed in on any astronaut safety risk associated specifically with the new, sped-up timeline?

And I have to tell you that that is a serious concern that I have heard from some people. By speeding it up, do we risk safety issues, do we run into safety issues?

Mr. BRIDENSTINE. I think there is a concern that I have heard and the concern is schedule pressure. Sometimes I think that schedule pressure is something we are concerned, it is a historically kind of challenging thing that NASA has to deal with, and the last thing we want to do is put any undue schedule pressure on anybody. That being said, I think it is important for us to have schedules, and I think it is important for us to be able to create milestones and then work to achieve those milestones.

I think when you talk about accelerating programs, a lot of people talk about schedule pressure, I want to make sure that people don't feel pressure from a schedule perspective, but at the same time that we are working every day to achieve milestones. It is a very delicate balance and we work on that every day at NASA, and we have great folks that have been working these issues for many years.

That being said, I think probably the ASAP has been focused on commercial crew, because that is the closest alligator to the canoe right now. I think we are getting to a good position on commercial crew, which is in the first part of next year we are going to launch American astronauts on American rockets from American soil for the first time since the retirement of the space shuttles, and I think that is going to be a great development.

Mr. SERRANO. Mr. Administrator, I, like Ms. Granger, saw the Moon landing on a small, black-and-white TV set, and it was very exciting. I just want to ask you a question off the wall here—

Mr. BRIDENSTINE. Okay.

Mr. SERRANO [continuing]. Out of left field, because I seem to remember as part of the conversation of the things we had learned or were able to create, if you will, as part of that whole mission, and one that I remember was something about the spacesuits having some abilities to move forward on people with disabilities or

something, I don't know. Do you know what I am talking about at all?

Mr. BRIDENSTINE. I am not familiar with that, but it is certainly something we could look into. Are you familiar with it?

Mr. BOWERSOX. No. We can look into it.

Mr. BRIDENSTINE. I will tell you, our goal and one of the reasons we are doing low-Earth orbit specifically commercially is because we want to see everybody be able to see themselves as flying into space. When we go to space commercially with maybe it is industry—what we are using the International Space Station for right now, two lines of effort that have transformational capabilities, one is industrialized biomedicine. The ability to compound pharmaceuticals in space in a micro-gravity environment is unlike what you can do on Earth. There are treatments that we can create in space.

Right now, we are proving on the International Space Station that we can create human tissue using adult stem cells. What that means is we could get to a day where we can print human organs in 3-D in a way you can't do it in the gravity well of Earth, because it just goes flat.

These are transformational, you know, industrialized bio-medicine kind of things that I think will result in a day where we have massive amounts of capital—I think we are 3 to 7 years away from massive amounts of capital flowing into commercial space industry for human habitation in low-Earth orbit. The goal is, we want to see a day when everybody can see themselves as being an astronaut and I think having more people have more access to space is really good for the American economy; it helps our balance of payments, it becomes an export for the United States of America, it reduces the trade deficit.

It is not just industrialized biomedicine, it is also advanced materials, it is fiber optics, technology we call ZBLAN, which will improve basically the way we do communications terrestrially, and other material sciences that can only be done in a micro-gravity environment of space.

I really think the goal is to have everybody know that space—we want space to be for everybody and we are making those investments to make that a reality.

Mr. SERRANO. Thank you.

Mr. Aderholt.

Mr. ADERHOLT. Thank you, Mr. Chairman.

I want to ask a little bit about commercial space launch vehicles. What commercial launch vehicles exist today or are in development that can or will be able to launch the HLS and get to the Moon to accomplish the goal of U.S. boots on the Moon by 2024?

Mr. BRIDENSTINE. Okay. If we are taking humans, the only rocket that is going to be available to take humans by 2024 is the SLS rocket with the Orion crew capsule. There is no other way to accelerate that program other than SLS and Orion. That is to carry humans to the vicinity of the Moon, namely the Gateway.

When we talk about what we need at the Gateway, we need a landing system, and that landing system could be carried to the Gateway. The only rocket that I can think of right now that exists would be the Falcon 9 Heavy, but there are a lot of other rockets

under development, you mentioned development. It would be the Vulcan, which is a ULA product; one would be the Starship, which is a SpaceX product; one would be the New Glenn, which is a Blue Origin product. I can't think of any others offhand.

Mr. BOWERSOX. There is a chance that Northrop Grumman Omega might be able to help as well. I am sure there are rockets we haven't even heard about yet.

Mr. ADERHOLT. Well, how many of those are currently flying?

Mr. BRIDENSTINE. The Falcon 9 Heavy is the only one.

Now, remember, and I think this goes to your question earlier, as you mentioned, there could be an SLS-derived commercial solution. We are not shutting the door on that opportunity. Of course, that would require some investment from Boeing to achieve, but certainly in the BAA that is an option.

Mr. ADERHOLT. How many of these rockets are going to have a full engine test equivalent to the green-run test of SLS by 2020?

Mr. BRIDENSTINE. I would say SLS and the Falcon 9 Heavy.

Mr. BOWERSOX. Yes, it is probably something that any responsible provider would do, but, that is going to be up to them since they are commercial activities. It is a typical type of test that you do preparing a rocket to go into space.

Mr. BRIDENSTINE. If we are putting American astronauts on those vehicles, without question, it is not just up to them, it is up to us as well.

Mr. ADERHOLT. And what is the contingency plan if for some reason the commercial rockets are not available by 2024?

Mr. BRIDENSTINE. Well, I think right now we have there is the Falcon 9 Heavy that is currently available and I think there are a number of others that are getting close.

Mr. ADERHOLT. If the commercial is not available, then what is the contingency plan?

Mr. BRIDENSTINE. Go ahead.

Mr. BOWERSOX. Well, I mean, we have got the potential for multiple commercial options, so we think that we would have all those options. If we didn't have any of those four vehicles flying, then we would look at what was available.

Mr. BRIDENSTINE. I think, Mr. Ranking Member, that would put us in a position to make landing in 2024 very, very difficult. If we don't have the additional rockets, then we are not going to be able to achieve the goal, but we are confident we will have those rockets.

Mr. ADERHOLT. It is a pretty simple fact that, the smaller the capability to take cargo to Moon orbit, the more launches you will need to carry out of Moon mission; correct?

Mr. BRIDENSTINE. Yes.

Mr. ADERHOLT. So I also want to focus in on Doug Cooke, who I am sure you are familiar with, former Associate Administrator for Exploration, he did an op-ed on September the 13th in The Hill, and in that op-ed he said that "NASA's 2024 approach will require eight new developments, eight launches, and approximately 17 mission-critical operations to achieve its goal," quote-unquote.

Are you familiar with that op-ed that he wrote last month and would you agree with that assessment?

Mr. BRIDENSTINE. So I do think—I have not read the op-ed, I would love to read it before commenting on it, if that would be all right, but I would be happy to take that for the record and give you my feedback.

Mr. ADERHOLT. Okay. How many commercial launch vehicles will it take—well, let me go back one second. I know you haven't read the article, but would you agree with what he—his assessment on that?

Mr. BRIDENSTINE. Can you say it one more time?

Mr. ADERHOLT. The approach would require “eight new developments, eight launches, and approximately 17 mission-critical operations to achieve its goal.”

Mr. BRIDENSTINE. I think that is a fair assessment.

Mr. ADERHOLT. Okay. And how many commercial vehicles will it take to launch the human landing system, including having the Gateway in the critical path?

Mr. BRIDENSTINE. So that is open. We are not telling the commercial providers how they need to do their landing system. Some providers would indicate maybe they could do it with just one vehicle, others indicate maybe you might need three. The BAA, the Broad Agency Announcement for the landing system is out and, because of that, I don't know how much we can comment on those activities because of the blackout.

Mr. ADERHOLT. Oh. So, basically, that is open right now?

Mr. BRIDENSTINE. We are not specifying how any of the commercial providers for the human landing system ought to—how their systems ought to be developed. We are waiting to have them tell us what their approach is and then we will assess their approaches.

Mr. ADERHOLT. Okay. NASA's 2004 Exploration System Architecture Study notes that after a launch plan requires more than six to eight launch vehicles the likelihood of mission loss goes up dramatically. Does that concern you?

Mr. BRIDENSTINE. Yes, I guess the point is, the more launches, the more one of them could have, you know, a problem.

Mr. ADERHOLT. Sure.

Mr. BRIDENSTINE. That certainly is an issue. I would also say we would need to look at the overall architecture and see what creates more risk and less risk, how we are building the architecture and for what reasons. You know, having a Gateway in orbit around the Moon is important for a lot of reasons. It is open architecture, so our international partners can have their own landing systems, you know, developed to be worked with the Gateway.

Again, the way we are building the architecture is strategic in nature, it enables us to get to the Moon, it enables our commercial partners to have opportunities to get to the Moon themselves, our international partners to have opportunities to get to the Moon.

I think in general we have to look at what we are trying to achieve, and then the cost and risk associated with that, and I think we have the right architecture at this point.

I would also say, when we use different types of rockets, we have dissimilar redundancy. That actually reduces risk, because, if one fails, another can continue to move forward. The challenge we had in the 1980s after the Challenger accident is DOD and NASA, ev-

erybody was entirely reliant on shuttle and, when it went away, we were done. The DOD had no access to space. Not a good position to be in in the 1980s, we don't want to repeat that.

Mr. ADERHOLT. This study I referred to, this 2004 study, it seems that it established benefits of using SLS-sized rockets for a lunar landing mission, from a mission- reliability standpoint. If that is the case, shouldn't NASA be working on completing SLS No. 4, since it may be needed to help with the Moon mission?

Mr. BRIDENSTINE. Certainly, in fact, we did a letter contract, I think we signed it this morning, for additional SLSs and exploration upper stage. These are underway right now and certainly we have a strong interest in seeing the fourth one be successful.

Mr. ADERHOLT. And you said that was created this morning?

Mr. BRIDENSTINE. Yes. Did the letter go out?

Mr. BOWERSOX. I think the announcement went out this morning—

Mr. BRIDENSTINE. Okay.

Mr. BOWERSOX [continuing]. The signature was a little bit earlier, I believe.

Mr. BRIDENSTINE. Okay.

Mr. ADERHOLT. Thank you.

Thank you, Mr. Chairman.

Mr. SERRANO. Ms. Granger.

Ms. GRANGER. Thank you.

China is ahead of us in space and I think we know this. People that are supportive of this request have said to me, if we don't move now, China will own space, and who owns space owns the Earth and our technology in it. Knowing that situation, how would the 2024 timeline to return to the Moon be affected if the funding isn't provided in 2020?

Mr. BRIDENSTINE. I think of it as a range of probabilities. There is no definitive can we get there early if we don't have the money or if we do have the money. It is a range of probabilities.

I think if we look at what the Senate mark was, it wasn't the entire budget request for the Artemis program, and because of that it reduces the probability of success to land within 5 years, but it can't be ruled out either. It is achievable, it is just the level of risk goes up. I am not talking about risk to life, I am talking about risk to schedule.

I think, when we move forward, we need to think about what puts us in the best probability of success. I think we put together a budget request that puts us in the best probability of success and I think that is what we are asking for.

Ms. GRANGER. Thank you.

Mr. SERRANO. Mr. Cartwright.

Mr. CARTWRIGHT. Thank you, Mr. Chairman.

Mr. Bridenstine. We have been talking a lot about the importance of commercial partners, which obviously will play a key role in getting NASA back to the Moon and beyond, right?

Mr. BRIDENSTINE. That is right.

Mr. CARTWRIGHT. And I was reading the 2020 budget request from NASA and also the \$1.6 billion supplemental request and they both speak a lot about how NASA plans to leverage innovative

commercial partnerships with launch vehicle providers and lander developers and companies like that.

I want you to go into some more detail on that. Would you please describe how these fixed-price partnerships are helping NASA to reduce costs and accelerate development in the Artemis program.

Mr. BRIDENSTINE. NASA is doing a lot of things, I think, rightly, that are accelerating processes. The transition is—and you are aware of this—that if we have a program we want to develop, we spend 6 months developing—maybe a year developing a request for information. Then industry spends 6 months to a year developing the information that we requested. Then we spend 6 months to a year reviewing that information and putting out a request for proposal. Then they spend 6 months to a year replying to those proposals.

Over the course of 3 to 4 years, we finally get under contract, and, by the way, that doesn't include when all of the contractors protest the decision that NASA made, which costs the taxpayers lots of money, wastes a lot of time, and creates all kinds of problems for the country, which is not good.

All that being said, what we are trying to do is we are trying to move faster, and the way to do that is where possible, where it makes sense, do, as you mentioned, partnerships with industry where we put forth American taxpayer dollars, they put forth their own private investment and collaboratively, we figure out what the solution is.

Now, we are willing to do that because we expect that they will one day go get customers that are not NASA. Those other customers could be international partners—by the way, we want to be in agreement with them on who those partners are—but not just international partners; it could be commercial people who want to go to the Moon for different reasons. Maybe it is a technology that can only be developed in the microgravity or the low gravity of the Moon.

It could be tourism. For goodness sake, there are people out there willing to go to the Moon for vacation. I don't think it would be much of a vacation, but many people do.

As long as there are people willing to invest money in the capability to have customers who are not NASA, it drives down our costs and it increases access for everybody. NASA doesn't necessarily want to always be the purchaser, owner, and operator of all of the hardware. That being said, there are times when it is in our interests to be the purchaser, owner, and operator of the hardware. Then, by the way, some of the companies that develop that capability can even offer that hardware as a commercial-like opportunity for the future. There are different ways of doing different things.

The goal that I think is important, is that we open the aperture of what is legally possible, and then stay within the confines of legal requirements that we have been given—don't go outside of that—but, ultimately, take advantage of what has been provided in the law to do public-private partnerships.

Mr. CARTWRIGHT. Thank you for that answer.

But knowing the vital part that private contractors are going to be playing, are you satisfied that NASA has enough personnel to

do the work of overseeing—the oversight work to make sure that the private contractors are doing what they are supposed to be doing?

Mr. BRIDENSTINE. I think at this point we are in good shape. As programs move forward in a more robust way, we may need to reconsider the number of personnel that we have involved in these programs. I think right now we are okay. If our budgets do go up and we have more development, we could need more support.

Mr. CARTWRIGHT. Thank you. I yield back.

Mr. SERRANO. Thank you.

Mr. Palazzo.

Mr. PALAZZO. Thank you, Mr. Chairman.

NASA has a solicitation underway for industry to provide a human lander system that will be used to land astronauts on the Moon in 2024. It is my understanding that the SLS, with this exploration upper stage could launch the entire lander system on a single mission. NASA does not appear to be offering its own SLS vehicle as an available option to launch the HLS; rather, the solicitation instructs bidders to come up with their own SLS-derived commercial cargo vehicle solution.

So, my question is: Has there been any discussion with NASA to offer the SLS as a government-furnished equipment to launch the lander system?

Mr. BRIDENSTINE. I haven't had any discussions regarding that with industry or folks that might have an interest in that. I do think this goes back to Representative Cartwright's question regarding kind of new approaches. Certainly, we thought it would be appropriate for SLS, if there is a commercially viable option for an SLS, that is an opportunity that any human-landing system provider or offeror could tap into, but that would be an agreement between them and, you know, Boeing for that activity or—I don't know—whoever. There are a lot of prime contractors involved in that program.

I have got to be really careful because we do have that BAA on the street. We don't want to say what the right answer is. We want to leave it to the HLS providers to make that determination.

Mr. PALAZZO. All right. And with that BAA, you might not be able to answer the next question: Will splitting the lander system into three missions and assembling the system on orbit negatively affect mission risks and schedule?

Mr. BRIDENSTINE. Again, we are going to have to look at what the commercial providers, you know, demonstrate they are capable of doing. We will look at all of that and make determinations in the source selection process. Again, we are in a blackout, so—

Mr. BOWERSOX. Yes, I don't want to talk about details, but, you know, the idea of doing everything with one big rocket versus doing it with smaller rockets, each approach has its advantages and disadvantages. One of the advantages of breaking things into smaller pieces is we tend to do better with smaller programs as we work through the management and production of those different items. Breaking them into chunks that we can handle could be very helpful.

One thing you mentioned—I think this is interesting—you mentioned government-furnished equipment. Certainly, any offeror for

a human-landing system has an option to request government-furnished equipment. If an offeror wanted to say to NASA, Hey, provide this as government-furnished equipment, in the BAA, that is perfectly appropriate for them to do that.

Now, what that means is we have to look at it and say, Do we have an extra SLS that is available and are we willing—and this is the other challenge—are we willing to pony up the costs for that additional SLS, should it be available? Right now, we are not appropriated for that activity; that is a lot of money.

I would say doing the GFE approach on that, again, I am not saying it's yes-or-no, offerors are going to have to offer, but it does look awfully challenging to accommodate that, just from an appropriations perspective, but also from a schedule perspective.

Mr. PALAZZO. Okay. Thank you.

And I really appreciate your written and oral testimony here today.

I yield back.

Mr. SERRANO. We have no further questions, here, but

I understand Mr. Aderholt—

Mr. ADERHOLT. If I could, what is the status of the parachute test in the Commercial Crew program?

Mr. BRIDENSTINE. Great question. My goodness.

We have two different Commercial Crew providers. SpaceX right now is rapidly iterating testing of the Mark 3 parachute, which is the most recent design and materials. The goal here is we are trying to meet a specific factor of safety of 1.6, which there is a whole host of numbers that go into that calculation.

We are confident that the Mark 3 parachute is the right system to achieve that margin of safety. What we are looking for now in that Mark 3 parachute is consistent and repeatable performance at that 1.6 level. We are going to be looking at the margins for every element of that parachute.

SpaceX has said that by the end of the year, they think they could get as many as 10 drop tests done on the Mark 3, which would be—you know, if that is possible, that would be very positive. Then we are going to look and see how that matches with the Mark 2, and if it matches with the Mark 2, then we might not need to do as many drop tests. If those parachute deployments do not match the Mark 2, then we would probably need to do additional drop tests.

These are all things that we are going to be analyzing in the coming days. With SpaceX, they have a static fire test coming up. They have a high-altitude launch abort test coming up, and then, of course, a lot of parachute testing. Remember, this is a development program; that means we are going to learn things that we were not anticipating and when that happens, we need to be prepared for it.

Then on the Boeing side, with the Atlas V rocket and the Starliner, a lot of the similar challenges with parachutes that come from the asymmetry issue from a parachute deployment are affecting them, as well. Again, NASA is making sure that what we learn in each of these programs gets widely shared because we are putting humans on these rockets and we can't afford to have proprietary information put some of our astronauts in jeopardy.

Mr. ADERHOLT. And lastly, of course NASA, unfortunately, has a reputation for overseeing projects that are sometimes over budget and behind schedule. My question is, what has changed and how are you hoping to overcome the difficulties of that, that you have seen in the past?

Mr. BRIDENSTINE. Yes. The big thing is, I think the number one thing that we have to do as an Agency is go forward with realism. A lot of times, a contractor will tell us what they can achieve and then we accept it and then they advertise it to the public—and this is true for every contractor; I am not singling out any one—and then those schedules get publicized and then we are held to account for achieving them.

I think in a lot of cases, it is not based on realism. When it comes to cost and scheduling, we need to be more realistic in our assessments and know that these programs—this is a big difference and a lot of people don't know—there is a big difference between development and operations. When we had the space shuttle, that was an operations capability. We knew that we knew that we knew that we knew that we had the shuttle. Yes, there were delays, but we had the shuttle.

What we are doing now with Commercial Crew and SLS, these are development programs, we don't know yet what we don't know. As we go through the development and testing, we learn things and then we have to make adjustments. It is a lot harder to pin down what a schedule is when you are not in operations and you are still in development. That being said, I do think we can get better at being more realistic at schedule.

I can see that Ken has some thoughts.

Mr. BOWERSOX. I think a big part of it is the initial estimates that we give people, right. You know, we tend to try and be a little ambitious and maybe a little bit optimistic in our initial cost estimates and schedule estimates and maybe we need to start off, you know, a little more—I won't say pessimistic—but realistic so we set out schedules and cost goals that we can meet.

Mr. ADERHOLT. And last, let me just—what type of issues continue to slow you down and what additional authority do you need to stay on budget and to stay on schedule?

Mr. BRIDENSTINE. There is a very delicate balance among the contractors involved in this process and, quite frankly, we need all of them and we need them all to be successful. A lot of times what happens is there is contractor-on-contractor violence that ultimately undercuts what we are trying to achieve on a rapid schedule.

Here's what we know: China is not going to slow down. That means that we, as a country, need to come together, figure out what the architecture is, be committed to a process and then move forward as rapidly as possible.

Sometimes, contractors are constantly undercutting each other and that is not good for the agency. It is not good for our country. When we make a plan to move forward, we need to move forward. I think that is one thing.

As far as authorities, I will take that for the record. I guarantee you, I will come up with some, but I might need a little time.

Mr. ADERHOLT. Okay. Thank you.

Thank you, Mr. Chairman, for the additional time.

Mr. SERRANO. Thank you.

That brings us to the end of the hearing, gentlemen, and notwithstanding whatever questions may have been asked or comments made, we support the work that you do.

Mr. BRIDENSTINE. Thank you.

Mr. SERRANO. We appreciate the work that you do. We can differ on one issue and try to work it out, but, again, as I look at my last year in Congress, I am proud of the fact that I was able to deal with issues that ordinary people would think I was stereotypically not capable of dealing with and NASA supporting other things, and at the same time, looking out for the guy and the woman who are, you know, paying rent for the apartment and having trouble paying their mortgage.

And so, all those folks who are already writing on Twitter, newspaper clippings, already—but not while we are sitting here—saying that I just killed the mission. I don't have that kind of power. I didn't kill the mission. I just asked some questions that I know that you know need to be answered before we move forward or not.

So, I thank you for your work. If you want a list of people that I want to send to space, I will let you know. I am capable of doing that. Send all the Houston Astros, but anyway, I sincerely thank you for coming here today and for participating.

And I thank you, Mr. Aderholt, for your input on making sure that we held this hearing. Thank you so much.

Mr. BRIDENSTINE. Thank you, Mr. Chairman.

[Material submitted for inclusion in the record follows:]

The Honorable Marcy Kaptur
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
NASA's Proposal to Advance the Next Moon Landing by Four Years

Artemis Exploding Budget

1. Administrator, I want to first thank you for visiting NASA Glenn and Plum Brook Station. The budget amendment requests an additional \$1.6 billion in FY 20, but this is just the tip of the iceberg. If Congress approves of this timeline, it would commit this committee to an additional \$25-30 billion for FY 2021-2024. What is the estimated total cost for the accelerated mission?

Answer: Further details about Artemis and budget runout data will be provided as part of the President's FY 2021 budget request.

2. The request to repurpose \$1.6 billion from Pell grants is a non-starter, and as a fellow cardinal on the Energy and Water Appropriations Committee, this committee cannot deal in the hypothetical. The American people expect the federal government to live within our means, which requires this committee to make hard choices. Has the Administration proposed future offsets to pay for the total cost of the \$20-30 billion Artemis mission? How do you suggest this committee cover the increased Artemis costs?

Answer: The President submitted an amended budget request requesting the additional funding for NASA needed in FY 2020 to get us out of the gate for a landing with American astronauts on the Moon by 2024. Decisions about funding source(s) supporting the President's amended request are made outside of the Agency.

3. Congress supports a return to the Moon. However, our committee, under Chairman Serrano's leadership has expressed concern about the rushed nature of the 2024 timeline. In particular, the budget amendment makes significant changes to the Gateway. I am concerned that the budget amendment ignores your scientists' recommendations about the gateway timeline. The Artemis proposal proposes a new phasing without clear direction to the Committee.
 - a. I have no choice but to agree with the Senate Appropriations Committee which stated in their report that "it is difficult to weigh the impacts of the accelerated mission on the overall budget of NASA with only a single year budget proposal."

What assurances can you provide that you are pursuing a scientific and not a political approach to what date NASA intends on landing a man on the moon?

Answer: The acceleration of the crewed Moon landing does not represent a fundamentally new program, but a faster path to achieve NASA's existing objectives. We need to learn how to operate in deep space again. The work we accomplish at the Moon over the next decade and beyond will ensure we can send the first humans to Mars. By focusing on accelerating our near-term efforts to land the first woman and the next man on the Moon in 2024, we will

not only begin to realize these benefits sooner, we'll also create a more effective and goal-oriented program. With the 2024 goal, we have the opportunity to challenge ourselves to remove inefficiencies in the system by spending time only on those activities that meet clearly stated national objectives. Innovative development strategies will not be implemented if the next human space exploration goal is too far in the future.

4. Specifically, why did you decide to propose that the moon landing occur in 2024?

Answer: Please see response to Question #3, above.

Solar Electric Propulsion

1. The NASA Glenn center is the center for Solar Electric Propulsion development and testing higher-power, longer-life thrusters and power processing units. The initial request was for \$43.4 million and this committee has proposed \$48.1 million for the program. However, the amended budget proposes \$58 million for the program. Can you help us understand more about the proposal and why this additional funding is needed? What changed in your planning to necessitate these additional funds?

Answer: The amended FY 2020 budget request for Solar Electric Propulsion is to meet technical and schedule requirements in order to meet the Advanced Electric Propulsion System schedule and Gateway Power and Propulsion Element requirements. In addition, the project required some changes in design and material for some of its long lead procurement items. The increase and associate funding profile align with the rebaselined NASA KDP-C baseline cost and schedule commitments (\$335.6M).

Regional Economic Development Program, Center at NASA Glenn.

Background--The FY 2019 appropriations house appropriations bill contained the following--**Regional economic development**--The recommendation includes \$7,500,000 for NASA's regional economic development program which focuses on partnerships with State and regional economic development organizations as they expand space-related commercial opportunities designed to address NASA mission needs.

1. In the final FY 2019 appropriations bill, Congress approved \$5 million in funding for Regional Economic Development. The Committee rejected the proposed elimination of the Regional Economic Development program and supported NASA's outreach to local businesses and communities with technology transfer and technical support to spur job growth through the exploitation of technology developed at NASA's world-class facilities. What assurances can you provide that the \$5 have not been diverted to unintended purposes?

Answer: NASA is committed to facilitating regional economic development as part of its strategic objectives, while also benefiting Exploration. NASA continues to support outreach to local businesses and communities with technology transfer and technical support; across all 10 NASA Centers. Regional economic development is achieved by utilizing the diverse NASA portfolio to aid under-represented regions across the nation while furthering NASA's

mission goals (particularly leveraging activities in SBIR/STTR and Technology Transfer programs). These activities totaled at least \$5.3M in FY 2019, consistent with NASA's Initial FY 2019 Operating Plan.

For FY 2020, NASA will continue to work with entrepreneurial and regional economic development ecosystems to bridge the gap between Center mission efforts and the surrounding business community needs. For example, the Lunar Power Ideation Workshop was held at GRC on September 18-19th with over 50 attendees from academia, industry, and other government agencies (including the Department of Energy) participating in the workshop. Also in FY 2020, the FedTech Program will hold a training session in Ohio, bringing teams of entrepreneurs together to conduct commercial assessments of select NASA technologies, leading to the creation of new companies in the region using NASA technologies.

2. I am also concerned that despite the appropriated funding, NASA has delayed implementation of RED. I would like your commitment that you will expeditiously allocate these funds and ensure that RED can do its job with technology transfer and outreach in FY 2019. It is also important that NASA utilize these funds for the intended purpose and not "account" for dollars spent on other activities as part of the \$5 million. NASA must have a clearer roadmap for promoting economic development with these funds and not allow infighting prevent professionals at Glenn from communicating with Local leadership. How many FTE's have been allocated to RED at NASA Glenn between FY 2015-2019? How many FTE's have been allocated to Glenn so far during FY 20?

Answer: From FY 2015-2018, there were three to five Glenn employees charging full time to conduct and coordinate Regional Economic Development.

Consistent with the FY 2019 Operating Plan, STMD funded three Glenn employees charging full time to coordinate and support Regional Economic Development activities.

Through the continuing resolution period, STMD is funding three GRC employees to support and coordinate Regional Economic Development activities.

Electric Air Flight

Background—The FY 2019 bill included the following language which directly impacts NASA Glenn's work in electric air flight.

Language included- Electric air flight—The Committee encourages and supports strengthening collaborations between NASA and the Department of Energy national laboratories to overcome energy storage challenges for novel modes of mobility like electric air flight. While NASA has unprecedented aeronautics expertise, the Department of Energy national laboratories are leading efforts to develop next generation battery technologies for vehicle applications and enhancing modeling and simulation capabilities with advances in deep learning and machine learning. Therefore, the Committee encourages increased cooperation between NASA and the Department

of Energy national laboratories to overcome technological barriers in demonstrating the capability of electrified aircraft, such as higher energy density batteries, development of new, lower-cost materials, and the establishment of testing methods and protocols.

1. Please elaborate on your efforts to cooperate with the Department of Energy on electric air flight aircraft and low-cost material development?

Answer: NASA coordinates with the Department of Energy (DOE) and its national laboratories to share research and identify challenges where we can leverage each other's capabilities and advances. For example, a battery workshop was held at NASA Glenn Research Center (GRC) in August 2017, which included active participation from the DOE and National Laboratories. That workshop initiated a regular dialogue between NASA GRC and the DOE Vehicle Technology Office and Argonne National Laboratory to increase their awareness of advanced battery technology needs for electric aviation. A second DOE-NASA workshop is planned in December 2019 at Argonne National Laboratory to assess battery technology needs for electric aviation and potential technologies to address those needs.

NASA GRC has also been working with DOE's National Energy Technology Laboratory (NETL) to develop and demonstrate advanced magnetic materials that enable more efficient, higher power density power systems for both terrestrial power generation and hybrid electric aircraft. Advanced magnetic materials developed by NASA GRC for electric motors have been tested by the NETL in power conversion systems. NASA has also supported various DOE technical meetings, proposal reviews, and workshops on technologies being developed by DOE with potential application in electrified aircraft propulsion.

2. I know NASA aeronautics has been working to enable safe all-electric or hybrid electric air travel in Ohio at the NASA Glenn facility. The challenges of a higher specific energy and higher power density battery to enable electric flight are limited by the chemistry. Is NASA confident that a chemistry solution is either in place or currently under development?

Answer: NASA's strategy for electrified aircraft propulsion looks at the needs of different classes of aircraft, ranging from small, electrified vertical takeoff and landing (eVTOL) aircraft for the urban air mobility (UAM) market up to increased electrification of propulsion for large, single-aisle commercial aircraft. The technology needs to enable these applications vary widely and involve not only advanced batteries, but also more efficient, higher power density electric components such as motors and inverters as well as advancements in jet engine technology.

The initial introduction of eVTOL aircraft for the urban air mobility market could be possible with the current state-of-the-art (SOA) batteries and near-term developmental batteries with improved chemistry that offer modest improvements in specific energy and power density. However, these initial aircraft would not have the desired range or power to enable the future UAM market. Similarly, initial introduction of 10-passenger thin-haul electrified propulsion aircraft could be possible with limited range capability utilizing the SOA and near-term developmental batteries. Reaching the full potential of electrified aircraft for UAM and thin-

haul markets will require 2-2.5X increase in specific energy and power density of batteries to meet project range and performance needs.

Weight is a major challenge for electrified aircraft propulsion, and considerable increases in specific energy and power density are needed to make batteries light enough for aviation applications such as eVTOL aircraft. Several battery chemistries and materials are currently under development to increase the specific energy of batteries for electric automotive applications. Despite significant challenges related to cyclic life, chemical stability, and durability with the new high specific energy battery chemistries, steady progress is being made by DOE national labs, academia, and industry to increase the specific energy of batteries by a factor of two or so. However, these advanced battery chemistries and materials do not address the power density requirements of eVTOL aircraft and may need to be optimized or new chemistries developed to address those requirements.

Extending battery-driven electric propulsion to regional and 737-class single-aisle aircraft would require significant increases in specific energy that are well beyond the scope of current research in battery chemistries and materials related to electric automobiles. While batteries could contribute to electrified propulsion architectures for these aircraft, there are concepts under study for large electrified aircraft propulsion systems which are not dependent on battery advances since those systems utilize turboelectric or hybrid-electric (i.e., not all-electric) subsystems.

3. The federal government has made a considerable investment at U.S. Department of Energy National Labs and U.S. Universities to develop new battery chemistries for multiple applications. Given the long history of the Department of Energy supporting power requirements for NASA space flight, could a similar arrangement address these needs for aeronautics?

Answer: A collaborative research model has worked well for development of nuclear space power systems for space flight requirements. In a similar way, coordinating research efforts between DOE national laboratories, industry, academia, and NASA could help advance development of new battery chemistries to meet aeronautics needs related to electrified aircraft propulsion by identifying the unique needs associated with aviation applications and leveraging the complementary strengths of different organizations to address those needs.

4. Would a closer relationship between NASA and the U.S. Department of Energy National Labs facilitate the development of a technical roadmap to identify new chemistries that meet the needs of NASA Aeronautics?

Answer: As noted previously, NASA coordinates with the DOE and its national laboratories on our respective research activities associated with electrified aircraft propulsion and battery technology. As part of this coordination, a workshop is being planned for December 10-11, 2019, at Argonne National Laboratory to assess battery technology needs for electrified aircraft propulsion. The workshop will have participation from both large and small aircraft manufacturers, DOE national laboratories, NASA, automotive companies, battery manufacturers, and academia. One potential outcome from

this workshop is an informal, notional technical roadmap for the development of advanced battery technologies. Such a working-level roadmap could allow researchers in the respective agencies to have visibility of each other's efforts and could provide inputs to the DOE on battery and materials needs for aviation applications and to the broader NASA research portfolio planning efforts. More importantly, though, the discussions at the workshop will build greater awareness between researchers at the participating organization to allow greater leverage of research results and capabilities.

5. I encourage you to work with the Department of Energy and U.S. Universities to develop a technical roadmap to address the energy and power density challenges mentioned above and to develop new chemistry solutions. What steps are you taking to collaborate with the National Labs on energy and power density challenges in electric air flight or in other areas?

Answer: Currently one of the battery development projects funded by the Convergent Aeronautics Solution project in NASA Aeronautics has strong collaboration with Argonne National Laboratory and Pacific Northwest National Laboratory to develop high specific energy battery technology. As NASA continues to coordinate with the DOE as described above, we may identify similar opportunities where collaboration makes sense to advance the objectives of both NASA and the DOE.

6. What other synergies could this electric air flight technology have across other research and development work at NASA?

Answer: Advanced batteries developed for electrified aircraft propulsion could benefit space flight missions as well. High specific energy batteries could reduce the weight of batteries and enable larger space payloads. Higher specific energy batteries could also extend the duration of extravehicular activities (EVA) in space.

Many other technologies being developed for electrified air flight technology could also benefit space exploration missions. For example, advanced magnetic materials currently being developed for electrified aircraft propulsion could increase the power density of the power processing unit for in-space propulsion systems, with the benefit of reduced weight for space propulsion systems. High voltage power transmission technology being developed for electrified aircraft propulsion could enable high voltage operation of space power systems, with the benefit of reduced weight and volume.

Communications Services Program

1. In the FY 2020 Budget, the administration has proposed a small funding line for the Communication Services Program. This \$3 million feasibility study will provide important information to guide NASA on upgrading our space communications system to manage its 21st century communications needs. Does the CSP program

have the potential to save taxpayers money, deliver more reliable communications and inspire a new generation innovation in space communications?

Answer: The Communications Services Program does have the potential to save taxpayers money and deliver reliable satellite communications (satcom) to NASA missions. NASA hopes to leverage the extensive commercial satellite capability currently available and be one of many users of commercial satcom services. By doing so, NASA will not have to maintain a Government-owned and operated satcom system, which should save the Agency (and the taxpayer) money. Additionally, the commercial satcom industry is very competitive, and service providers have to provide reliable and innovative capabilities, or they will not be able to compete in the market. NASA plans to leverage those capabilities for NASA users.

2. What are some of the efficiencies gained through a next generation communications system proposed in CSP?

Answer: Since NASA plans to be one of many users of commercial satcom services, NASA will not have to pay for all the satellite and ground infrastructure required for a Government-owned and operated system.

3. Could you provide some examples of the impact the aging space communications infrastructure has on degrading performance?

Answer: NASA's three space communication networks continue to provide over 99 percent proficiency to missions. Of the three NASA space communication networks, the one with most concern for aging infrastructure is the Deep Space Network (DSN), with complexes located at Goldstone, California; Madrid, Spain; and Canberra, Australia. While new antennas are currently in development, some of the current antennas are several decades old.

The other two networks are the Space Network (SN) and Near Earth Network (NEN), which support missions in Low Earth Orbit (LEO). The SN ground infrastructure is located at White Sands, New Mexico; Blossom Point, Maryland; and Guam. Reliability predictions have the Tracking and Data Relay Satellite (TDRS) fleet (which is the portion of the SN based in space) providing support to missions to the mid- to late-2030s. The NEN primarily utilizes commercial service providers for its ground infrastructure.

The following are examples of concerns due to aging infrastructure:

1. Increased maintenance downtime to ensure sustained operations (especially the case with the DSN and more specifically the 70-meter antennas);
2. Unplanned downtime due to system failures;
3. Maintaining state-of-the-art communication standards/infrastructure monitoring systems;
4. Hardware obsolescence, including parts for Goldstone Solar System Radar – Used for radio astronomy/science, planetary defense, and mission planning;
5. IT security with aging infrastructure;

6. Goldstone Electric power cabling;
7. Potential health impact due to asbestos in older buildings.
 4. Could the CSP program have redundancy built into its model, and if so, what are advantages to building a more agile communications system if we do not invest in a new generation network?

Answer: CSP plans to utilize multiple providers for commercial satcom services so the Agency will not be reliant on any single service provider. This should provide built-in redundancy and allow for a robust set of services to be provided to NASA missions. Also, the commercial satcom industry is very dynamic, with new capabilities coming online every year. NASA plans to take advantage of the dynamic and agile nature of the commercial satcom market.

5. Is it in NASA's and the taxpayers best interest to maintain our own communications network or to focus on technological innovations, exploration, and scientific advances that cannot be matched by the private sector?

Answer: When NASA first started to develop the Government space communications network (i.e., the TDRS) in the early 1980s, the commercial satcom market was in its infancy. There were very few commercial satellites in-orbit and very limited bandwidth. Today, the commercial satcom industry is mature and generates hundreds of billions of dollars of revenue through hundreds of operational commercial satellites. NASA is working to transition from government-owned and operated systems to commercial capabilities; this has the potential to free up NASA to focus on deep-space exploration and advanced technology development. Existing commercial services exist to serve customers located on or close to Earth, so NASA will likely need to continue to invest in the communications infrastructure necessary to support missions to the Moon, Mars, and other destinations in the solar system for the foreseeable future.

6. NASA's infrastructure is aging, and it will be increasingly more expensive to upgrade and operate. The agency has already decided to no longer build and deploy TDRS relay satellites. The US satellite industry is expanding its services globally and is demonstrating capabilities to provide services to NASA space missions at great value to the taxpayer. DoD has already begun to leverage these capabilities. How will this feasibility study allow NASA the option to gradually shift to US industry communication networks to replace its aging infrastructure if it proves cost effective?

Answer: CSP plans to have an initial demonstration phase which will feature multiple projects to demonstrate the effectiveness of commercial satcom to meet NASA mission needs. These demonstration projects will be important in providing NASA with the confidence that its mission requirements can be effectively met and transitioned to commercial services.

7. NASA's infrastructure is aging, and it will be increasingly more expensive to upgrade and operate. Thus, the agency has decided to no longer build and deploy TDRS relay

satellites that provide government owned communication services to its missions. Why is NASA pursuing Commercial Satellite Communications Services?

Answer: See response to question #1

8. Why is NASA no longer building TDRS satellites? The TDRS constellation was specifically built to support human space flight in low earth orbit (LEO). With the retirement of the Space Shuttle in 2011 and the ISS in the late 2020's, NASA will no longer have a permanent human presence in LEO. The existing TDRS flight has enough capability to support NASA through its current mission set, but we need to act quickly to introduce the new architecture to meet NASA as well as other government agency needs.

Answer: See response to questions #1 and #5.

9. How will the TDRS relay satellite network be replaced? It is critical for the United States to have its own relay system in GEO orbit. Chinese, Europeans, Russians, and Indians are building their own systems. To stay competitive, US commercial satellite networks offer the most cost effective and efficient services for NASA at this time. The agency can also add their own hosted payload on the commercial network system to continue their technological innovation.

Answer: See response to question #6.

10. In the early days of NASA, there was no space infrastructure, and NASA had to develop the capabilities to meet its unique requirements. As the commercial space communications industry has matured and far exceeded the NASA investment in R&D NASA will just become one of many users of commercial satcom services and no longer be required to invest hundreds of millions /billions of \$'s in infrastructure. This will free up more funds for NASA to focus on exploration. Why not continue with government owned, contractor operated communications infrastructure?

Answer: See response to question #5

11. Can the commercial satcom industry meet NASA's mission needs? A number of NASA funded studies have all reported that the commercial satcom industry can meet many of NASA's future satcom requirements. Many government agencies routinely use the commercial satcom industry services to meet their mission requirements. The DoD procures \$100's of millions in commercial satcom services contracts annually to enable the combatant commands to execute their mission. \

Answer: See response to question #6.

DOD-NASA

1. The Administration has begun to prioritize Nuclear Thermal Propulsion to expand our ability to reach deep space. Could you provide specific examples of promising cross agency partnerships in technologies necessary for space flight?

Answer: NASA sees the opportunity for a number of partnerships between agencies as we progress with Artemis. As noted, NASA is working with a number of government partners in its nuclear work. Irradiation testing is being performed in partnership with the Department of Energy (DOE) at Sandia National Laboratory's Gamma Irradiation Facility and at Oregon State University. In addition, NASA and DOE are collaborating on fuel element and reactor design and fabrication for a Low Enriched Uranium-based propulsion system. NASA, DOE and Department of Defense are working to develop a common fuel source for special purpose reactors. Shared investments will address key challenges of the TRIStructural ISOTropic fuel form that will inform both NTP risk reduction and flight demo formulation. The Agency also has notable partnerships in the Laser Communications Relay Demonstration and High-Performance Spaceflight Computing with various organizations supporting the Department of Defense (DOD). In addition, NASA hopes to continue working with the Department of Energy in FY 2020 on its Kilopower nuclear fission power work. There is some interest in this technology from DOD as well, though there is no direct contribution. Kilopower is one of several potential approaches to nuclear power on the surface of the Moon and on to Mars. Further collaborative opportunities will be explored including the use of HALEU (High Assay Low Enriched Uranium) for power applications to address proliferation concerns. Fission reactors with surface and in-space applications are a priority for NASA, and this work will also support space nuclear propulsion work in the long term.

2. Why is NTP so important to the long-term space exploration mission?

Answer: Currently, it is not known whether Nuclear Thermal Propulsion (NTP) will be important or beneficial for long-term space exploration missions. It is among many technologies that offers potential advantages for exploration missions beyond cislunar space.

In terms of advantages, NTP can reduce the trip time to Mars for a crewed mission by approximately 20 percent. Further reductions to the total mission time are achievable given the greater flexibility NTP provides in mission planning due to its performance advantages. In addition, NTP can enable abort modes not available with other architectures, including the ability to return to Earth anytime within three months of the Earth departure burn, and can also provide the ability to return immediately upon arrival at Mars. As a result, an NTP-based system could reduce crew exposure to space radiation, microgravity, and other hazards. NTP also offers the potential to reduce the cadence and total number of SLS launches required for human missions to Mars and other destinations. The performance advantages NTP provides offer the possibility to aid other cislunar or deep space missions. For example, the NTP performance capability could enable a mission that requires rapid orbital changes. However, NTP does not offer sufficient performance advantages to be an enabler for interstellar travel in reasonable timeframes, as it would still require tens of

thousands of years to reach the closest star system. It could provide enhanced performance for prospective deep space missions within the solar system.

NTP is still in the research and development phase, and NASA is currently conducting system feasibility assessments and concept studies to determine the viability of meeting these objectives.

3. Can you please provide more details on when the administration will finalize the NTP program funds for previously appropriated dollars?

Answer: NTP is currently utilizing FY 2019 carryover funds to continue fabrication and testing of sub-component fuel element articles for mission simulation loading, and extreme temperature survival. The series of tests are targeted for completion in April 2020; the results are key to identifying a viable path forward to a reliable reactor design. In addition, NASA has initiated both government- and industry-led studies as a pre-formulation effort prior to initiating full design of an NTP flight demonstration. The government-led studies include NASA, DOE, and DOD representatives. There are over 10 companies supporting the industry led study. NTP FY 2021 and outyear funding will be determined as part of the President's FY 2021 budget request, currently targeted for release in February 2020.

4. Given that we are currently in a CR, that Congress appropriated funds for NTP in FY 19 and both the House and Senate passed bills have funds for NTP in FY 20, please elaborate on your current NTP activities with FY 20 money under the CR.

Answer: NTP tests performed during FY 2019 showed that the primary reactor design approach using packed powder canisters would not meet NASA's human mission reliability requirements. Moving into FY 2020, NTP will focus on advancing a solid core design that has shown robust performance from the preliminary testing conducted in FY 2019. Results from the April 2020 fuel articles and subcomponent testing will guide the reactor fuel form and fuel element design, which will in turn guide NASA's future funding decisions for an NTP flight demonstration concept. In addition, NASA has initiated both government- and industry-led studies as a pre-formulation effort prior to initiating full design of an NTP flight demonstration. The government led studies include NASA, DOE, and DOD representatives. There are over 10 companies supporting the industry led study. Other system needs for an NTP in-space transportation capability, such as composite propellant tanks, reduced gravity propellant transfer, mass gauging, and cryogenic fluid management are also continuing as planned in FY 2020.

5. Can you please provide information on NASA's plans to deliver the in-space NTP demonstration by 2024?

Answer: NASA has initiated both government- and industry-led studies as a pre-formulation effort prior to initiating full design of an NTP flight demonstration. The government led studies include NASA, DOE, and DOD representatives. There are over 10 companies supporting the industry led study.

The flight demonstration objectives are to: identify schedule-driven flight demonstration concepts; establish solid projections for schedule, cost, and performance; and provide peer-reviewed results, documents and briefings to inform decisions. Two flight demonstration options are being considered:

- (1) FD1 Mission: near-term; emphasis on schedule over performance, using known capabilities and mature hardware designs. This would be the concept to attempt to achieve a 2024 flight demonstration.
- (2) FD2 Mission: mid-term; emphasis on performance over schedule. Utilize technologies and hardware designs that can be extensible to the system needed for human Mars exploration.

The preliminary FD1 results indicate the mission is feasible with an optimistic 5-year development schedule. However, the engineering system performance has very limited relevance for NASA missions and the exercised technology is not extensible to a Mars human spaceflight architecture. The consensus of the technical community is to not pursue this option.

The FD2 mission results will be completed in spring 2020. A key consideration for the FD2 mission is assessment of the risk posture of proceeding with a flight demonstration design while the technology has not yet been demonstrated in the laboratory. There have been significant challenges in nuclear fuel development for this system with alternative designs being pursued by NASA in coordination with DOE and industry. Until a viable fuel form and element are demonstrated, it would be premature to proceed with a detailed design of a flight system. Lessons learned from previous missions demonstrate that implementation of a technology into a flight system prior to readiness consistently leads to significant cost increases and schedule delays on the flight design. Upon completion of the ongoing technology development activities and the FD2 flight demonstrator studies, NASA will be able to determine the approach for an NTP flight demonstration and will share that plan with Congress.

6. The Ohio State university has a crucial role with the development of Nuclear Thermal Propulsion. Can you please elaborate on parts of the NTP that OSU is working on with NASA and other industry partners?

Answer: NASA is indirectly working with Ohio State through its work with BWXT, where they are conducting joint interdisciplinary research to advance nuclear thermal propulsion technologies for space flight missions. Ohio State's world-class materials science capabilities, robust data analytics expertise and its own nuclear reactor laboratory complement BWXT's applied science leadership in nuclear propulsion.

7. NASA's work cannot exist in a silo. American excellence in space leads the nation's science mission and as such, must connect with work at the other research missions within the federal government. Are there additional collaborations between DOD and NASA on electric air-flight or in other technologies that are critical to NASA's missions? Please provide examples of collaborations that advance the national security mission.

Answer: NASA and DOD are working together on the Laser Communications Relay Demonstration and High-Performance Spaceflight Computing. In addition, there is some interest from DOD in the Kilowatt surface fission power technology NASA is hoping to utilize on the Moon and Mars. In addition, the Department of Defense is monitoring progress on a number of small spacecraft technologies due to common interest in seeing technology progress on this platform. This includes missions demonstrating cooperative operations, communications and propulsion.

NASA coordinates with DOD on electrified aircraft propulsion and electric air-flight through multiple forums to maintain awareness and leverage complementary research efforts that offer potential benefits to both military and commercial aircraft. In addition, NASA works closely with DOD in other areas such as hypersonic flight. For example, the DOD tests advanced hypersonic technologies in NASA's unique facilities to mature these technologies and reduce risk for future DOD applications.

The Honorable Robert Aderholt
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
NASA's Proposal to Advance the Next Moon Landing by Four Years

SPENDING OF EUS FUNDS

Mr. Administrator, on page 2 of your testimony, you note that spending of EUS funds has been in accordance with appropriations bill directions. I have heard recently that EUS funds are being used for booster work.

1. Since that is not needed, I think, until SLS rockets numbers 7 and 8, shouldn't that work be requested separately?

Answer: NASA is spending Exploration Upper Stage (EUS) funds in accordance with appropriations bill directions. Funding for Space Launch System (SLS) boosters is part of NASA's SLS budget request and separate from EUS funds.

SLS SUBCONTRACTING, READINESS AND COST

2. My understanding is that the Block 1 and the first Block 1B are under the existing contract. Congress has directed that the EUS and the SLS cores be built simultaneously. I know of no reason why all the parts should not be ordered by now for SLS rocket number 3 at a minimum. Likewise, the "green light" should be on at NASA for work to proceed without delay. Please confirm that this is the case, and if it is not, by whose direction at NASA or otherwise the work is being delayed.

Answer: While the SLS Block 1B configuration remains an important future capability, NASA's near-term focus is the successful completion of Artemis I, II, and III and supporting a reliable annual flight cadence. Pursuant to Congressional direction to develop the Block 1B, NASA aims to use the first EUS on the Artemis IV mission, and additional core stages and upper stages will support crewed Artemis missions. Significant performance challenges with Boeing's completion of the Block 1 vehicle require that NASA and its contractors concentrate in the near term on the successful completion of Artemis I core stage, recognizing that a four-year lead time for development of an integrated vehicle design results in the SLS Block 1B final design efforts targeting Artemis IV. This approach is necessary to ensure safe and reliable lunar surface exploration and increase the sustainability of the exploration program.

3. I understand that the Europa mission is unlikely to be ready in 2023. The PBR has it listed for 2025. Meanwhile, we are waiting for a number of commercial rockets to make their first appearance in flight. All this makes it prudent to complete the SLS Block 1 rocket and first Block 1B rocket by 2024. I understand that the manufacturing process for major portions of the rocket have improved anywhere from 40% to 75% in terms of labor hours. If you agree that it would be helpful, could you host a briefing for yourself, OMB, and Space Council staff to hear the latest developments from the program manager and the prime contractors?

Answer: The 2020 President's Budget proposed to launch the Europa Clipper mission in 2023 on a commercial launch vehicle. Commercial vehicles that could launch the Clipper mission are currently available. We continue to be deeply concerned about direction to launch the Europa mission on an SLS, which will negatively impact human space exploration programs and cost taxpayers over an additional \$1.5 billion.

4. When SLS flight costs are estimated as potential launch vehicles for the HLS or other programs, the SLS program is bearing 100% of the fixed costs of related NASA facilities, activities and staff costs even though those also benefit other work, including commercial launch. For example, the salaries maintained for NASA personnel who provide a government resource available to all commercial companies. Please share with me some ways in which NASA can calculate the cost benefits to commercial providers of the SLS budget, especially the personnel supported.

Answer: Development of the SLS includes institutional investments at the Marshall Space Flight Center (MSFC) in facilities operations and maintenance, information technology, and personnel. These investments cover both normal operations at the Center, as well as MSFC's world-class engineering knowledge base. NASA plans to make this engineering and other MSFC expertise available to Human Landing System (HLS) contractors through the HLS contract's concept of Collaboration. The cost to NASA of providing these resources to HLS contractors will be calculated and accounted for by the HLS program during contract administration.

As the primary tenant at the Michoud Assembly Facility (MAF), SLS covers a significant amount of the costs to operate, improve, and maintain the facility. Commercial entities, like Northrop Grumman utilizing facilities at MAF to build the cryogenic propulsion stage of their Omega rocket, are subsidized by the infrastructure investments made by the SLS program.

Similar investments at Kennedy Space Center by the Exploration Ground Systems (EGS) in facilities like the Converter Compressor Facility are able to be leveraged by other launch vehicles that will be launched at Kennedy Space Center (KSC) and Cape Canaveral Air Force Station (CCAFS). The Omega rocket currently plans to leverage much of the same ground infrastructure developed already for SLS (Crawler Transporter, LC39B pad infrastructure, a separate VAB High Bay).

Additionally, the aerospace industry benefits from suppliers that have been able to upgrade systems for advanced technology or greater efficiency as a result of NASA investments. One such example is Aerojet Rocketdyne's use of state-of-the-art additive manufacturing to build future RS-25 engine components like the pogo accumulator (used to dampen pressure oscillations that can cause flight instability).

More aerospace supplier companies help to drive down costs for all through competition in the growing space industry. By growing the supplier base, NASA is paving the way for future commercial endeavors.

5. Please discuss the potential launch schedule impact (and therefore the cost impact) on the SLS program resulting from NASA having provided an exclusive 20 year lease of one of the only two Saturn V-size launch pads to a commercial company, and how NASA can calculate the cost pricing benefit created for any commercial launch company when government launch pads are leased for low prices as a substitute for the launch companies having to construct and maintain their own pads.

Answer: In 2014, NASA signed an agreement with SpaceX for use and operation of Launch Complex (LC) 39A at Kennedy Space Center (KSC) for 20 years, part of NASA's continuing process to transform KSC into a 21st century spaceport. This arrangement does not delay or otherwise affect the SLS program, and permitting the pad's use and operation by a commercial space partner will ensure its continued viability and allow for its ongoing use in support of the Nation's space activities, allowing SpaceX to use national assets that would otherwise sit empty.

6. In responses to questions about the BAA, NASA has suggested buying SLS rockets as a "commercial" process involving negotiations with five prime contractors. Such a process does not work as long as NASA is the integrator. A commercial approach could be beneficial to both customers and the taxpayer. Is NASA now ready to relinquish the integrator role to a private sector lead, and how soon can Congress expect to see action on that?

Answer: NASA will continue to serve as the integrator for Agency-operated missions (e.g., Orion flights). In the case of the Human Landing System (HLS) BAA, proposers are required to deliver the HLS to NASA in cislunar space. They will be responsible for the assembly, integration, launch, and operation of the vehicle until NASA astronauts board the vehicle. Proposers may engage with launch vehicle manufacturers to acquire assets required to launch the HLS. There are a number of potential launch vehicles that may meet the offerors' HLS requirements, but that choice is up to the offerors, as NASA simply requires that the HLS contractors deliver the integrated systems. One option for offerors to achieve this requirement could be through the use of a commercially-provided, SLS-derived cargo launch vehicle. If this option is selected by the vendor, they will be responsible for developing and integrating this vehicle. The offeror will be required to work with the necessary contractors to provide an integrated launch solution. On a non-interference basis, and if NASA determines that it is otherwise feasible from a funding perspective and in NASA's best interest to do so, NASA may make unique facilities and resources pertinent to launch available to HLS upon request.

LANDERS PLAN – REUSABILITY

7. Did the original Landers plan require reusability as a factor?

Answer: The President's Space Policy Directive-1 instructs NASA to lead an innovative and sustainable program of exploration. Although NASA considered reusability as an initial potential HLS requirement as a means to achieve sustainability, extensive market research through communication with industry indicated that requiring reusability is unduly restrictive insofar as it may not be the most cost-effective or technically sound approach to sustainability.

The HLS solicitation thus defines “sustainable” as an HLS design that incorporates long-term affordability, as well as numerous technical capabilities indicated by NASA as “sustaining” in the HLS Requirements document. Offerors are free to propose reusable HLS approaches to achieve NASA’s sustainability requirements, but are also free to propose other approaches to sustainability that meet these indicated sustainability requirements. NASA remains committed to allowing industry to propose the best and most cost-effective solutions to achieving sustainability while meeting NASA’s other mission requirements and goals.

8. If so, why was that eliminated? And if so, what does mean in terms of whether the government would pay for the next round of Lander systems?

Answer: Please see response to Question #7, above.

LANDERS PLAN – SCHEDULE, RISK, AND COST

9. As you are aware, Commercial Crew was planned to be online by 2015, but the first flights will be in 2020. As an example of commercial launch development, the Air Force contracted for a Falcon Heavy rocket in 2012, with a flight by 2014, but the rocket’s first flight was not until 2018. Given the time frame and the complexity of the HLS mission, why do you think commercial providers can complete the launch vehicles and other HLS components with sufficient safety systems included by 2024?

Answer: The 2024 schedule is dependent upon the timely availability of appropriated funds.

10. What calculations have you done to determine the extra cost of designing and assembling a human lander in space as opposed to preparing an integrated lander prior to launch and what was that extra cost?

Answer: The HLS solicitation does not prohibit offerors from proposing a lander that is integrated prior to launch, nor does it favor or encourage HLS designs that are integrated in cislunar space; HLS offerors are free to propose launch and HLS technical approaches that best meet NASA’s stated requirements and goals. In accordance with the solicitation’s terms, NASA will evaluate the advantages and disadvantages of offerors’ approaches to execute the mission, including any risks associated with the aggregation of major lander components in cislunar space as appropriate. By design, NASA’s acquisition strategy for HLS is to solicit for diverse proposals that empower industry to develop the most cost-effective, technically-advanced approaches to meeting NASA’s essential functional performance requirements.

11. The SLS rocket will be put through a "green run" test this summer. I understand the rocket will fire a full launch sequence while bolted down to a test stand at NASA's Stennis Space Center in Mississippi. The Commercial Launch Vehicles (CLV) will carry habitats and Lander components which, along with the Orion capsule, must keep our astronauts alive. If engine tests were equivalent in testing quality, there would be no “green run” of course. What benefits would there be for mission risk and safety if CLV’s were also required complete a green run test at Stennis?

Answer: It is important to note that NASA is purchasing commercial services for the implementation of certain components of its lunar exploration program (vs. owning and operating every system). In evaluating commercial proposals, the Agency takes into account test programs in order to reduce mission risk and ensure safety.

12. Can you confirm that U.S. astronauts on both the ISS Crew flights, and the HLS mission, will wear uniforms displaying the NASA insignia?

Answer: NASA astronauts will wear flight suits displaying the NASA insignia.

INTERNATIONAL PARTNERS

13. Have any of our international partners offered to help in a monetary way to help build and operate the Gateway?

Answer: When NASA sends the first woman and next man to the surface of the Moon by 2024 as part of its Artemis program, it will not be going alone. The Agency will be leveraging support from commercial partners and the international community as it establishes a sustainable presence on the lunar surface by 2028, paving the way for human missions to Mars. This includes critical international partnerships on the Gateway, as Gateway is our planned staging area for lunar surface exploration, and missions deeper into the solar system, including Mars.

Both the Governments of Canada and Japan have committed to make resources available for cooperation on the Gateway. The European Space Agency made a similar commitment at their Council meeting at the Ministerial level in late November. Roscosmos has also expressed interest in cooperation on Gateway. NASA is discussing potential mutually beneficial cooperation with these partners.

ARTEMIS II

14. When will you announce the launch date for Artemis II, and when will you announce the names of the astronauts for that mission?

Answer: The Artemis I and II launch dates will be evaluated by the new Associate Administrator for Human Explorations and Operations, and will be announced in the months ahead, as well as the crewmembers for Artemis II.

ORION

15. Do I understand correctly that the next milestone for Orion is delivery to the Plum Brook Facility in Sandusky, Ohio, for testing?

Answer: That is correct. Orion was delivered to Plum Brook Station in Sandusky, Ohio, on November 26, 2019, for environmental testing, to be conducted in two phases:

- a thermal test, which will last approximately 60 days, while Orion's systems are powered-on under vacuum conditions that simulate the space environment; and,
- an electromagnetic interference and compatibility test, lasting about 14 days, to ensure the spacecraft's electronics work properly when operated at the same time.

After successful completion, the spacecraft will return to NASA's Kennedy Space Center, where it will begin integration with SLS rocket and other pre-launch preparations in advance of Artemis I.

.16. When do you expect to deliver it and what is the goal of the next test?

Answer: Please see response to Question #15, above

The Honorable Steven Palazzo
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
NASA's Proposal to Advance the Next Moon Landing by Four Years

1. NASA has a solicitation underway for industry to provide a Human Lander System (HLS) that will be used to land astronauts on the Moon in 2024. NASA does not appear to be offering its own Space Launch System (SLS) vehicle as an available option to launch the HLS, rather the solicitation instructs bidders to come up with their own "SLS-derived commercial cargo vehicle solution." Why isn't NASA offering SLS as government furnished launch vehicle for the HLS?

Answer: Given current resources, schedules, and technical challenges, NASA cannot offer an SLS cargo vehicle as Government-furnished equipment for the 2024 landing. However, the Human Landing System (HLS) solicitation's requirement for a commercial launch solution does not prevent or preclude offerors from negotiating with the SLS and Exploration Ground Systems prime contractors directly to provide an SLS-derived commercial cargo vehicle solution for the Artemis launch mission(s) in which NASA is not the integrator or provider. NASA welcomes all proposals that demonstrably meet NASA's technical, schedule, and cost requirements.

2. Can the SLS's exploration upper-stage launch the entire HLS on a single mission, and wouldn't it take multiple launches of expendable, commercial heavy-lift launch vehicles to launch the HLS?

Answer: The ability of SLS to launch an entire HLS or the required use of multiple launches are both dependent on HLS offerors' unique HLS technical designs and approaches. As HLS is an active procurement, NASA cannot comment on the advantages and disadvantages of different proposed HLS architectures and mission profiles at this time. As provided in the HLS solicitation, NASA is thoroughly evaluating each offeror's proposed approach, including approach to launch, as part of its HLS award determination(s).

- a. Is splitting the HLS into multiple missions and assembling the system on orbit the best way to reduce mission risk and maintain schedule?

Answer: Please see response to Question #2, above.

- b. What commercial launch vehicles exist today, or are in development, that can or will be able to launch the HLS and get it to the Moon to accomplish the goal of U.S. boots on the Moon by 2024?

Answer: Please see response to Question #2, above.

- c. What other launch vehicle exists today, or is in development that can deliver the Orion crew capsule to the required destination in cislunar space?

Answer: The Space Launch System (SLS) is the only launch vehicle planned for the Orion crew vehicle.

- d. How many Falcon Heavy launches would it take to launch the full HLS system? Would the required Falcon Heavy missions be expendable or reusable rockets?

Answer: Please see response to Question #2, above.

3. Has NASA assessed the risks associated with reliance on commercial launch vehicles that are under development with Air Force funding?

- a. If so, what does the assessment indicate?
- b. If that assessment has not been conducted, why hasn't it been?

Answer: NASA has assessed the viability of CLVs for use in the Artemis campaign. As a result, we are confident we will have access to adequate CLV capability from U.S. industry in the timeframe necessary for the campaign. NASA's Advanced Exploration Systems Division will rely on input and analysis from the Launch Services Program, as necessary, when more CLV options come online. NASA believes that partnering with multiple providers will reduce risk and increase the chances of mission success (as opposed to relying on a single vehicle or provider).

4. Have NASA and the Air Force coordinated their respective requirements for, and availability of, commercial launch vehicles to accomplish national security and lunar exploration missions in the timeframe required?

- a. If so, will there be enough launch vehicle capability within the required timeframe(s) to accomplish both mission sets?
- b. If this coordination has not occurred, why not?

Answer: NASA, through its Launch Services Program based at Kennedy Space Center, routinely coordinates with both the National Reconnaissance Office (NRO) and the Air Force launch community regarding launch related technical matters, launch range scheduling, out-year launch forecasts, etc. As the exploration commercial launch requirements become more defined, they will be shared with our Air Force and NRO colleagues. It is difficult to be certain of the future; however, NASA is confident U.S. industry is up to the challenges of supporting both NASA and National Security missions.

5. Will NASA's current approach of commercially acquiring HLS and launch services for the HLS mission allow for a human lunar landing by 2024?

Answer: Acquiring HLS and its launch from commercial providers is the only viable approach to achieving a human lunar landing by 2024. That being said, that approach remains entirely dependent on the timely appropriation of adequate funding for the HLS program.

6. The FARs state that BAAs are to be used "for the acquisition of basic and applied research and that part of development not related to the development of a specific system or hardware procurement" (reference: FAR 35.016). This statement, directly from the FARs, seems to be in conflict with NASA's HLS BAA which states, "the purpose of this solicitation is to facilitate the development and demonstration of a HLS."

- a. **Why is NASA using a BAA to procure the HLS? How is doing so in the best interests of our National objectives and, most importantly, the taxpayer?**

Answer: Through the HLS solicitation, NASA intends to acquire research and development (R&D) related to a human landing system. This is not targeting a "specific system," but rather, a technical solution for landing the next human on the Moon by 2024. As provided in FAR 35.016, Broad Agency Announcements (BAAs) may be used by agencies to fulfill their requirements for scientific study and experimentation directed toward advancing the state-of-the-art or increasing knowledge or understanding, and that is what the HLS solicitation endeavors to do. NASA has provided only 26 functional performance requirements for a lunar landing system that does not yet exist, thereby allowing industry to perform R&D specific to each offeror's unique technical vision and preferred approach for a lunar lander.

HLS was solicited as an Appendix BAA to the omnibus Next Space Technologies for Exploration Partnerships (NextSTEP) BAA. A key feature of the NextSTEP partnership model is that it provides an opportunity for NASA and industry to partner to develop capabilities that meet NASA human space exploration objectives while also supporting industry commercialization plans. This is consistent with NASA's overall policy of stimulating the U.S. commercial space industry to help the Agency achieve its strategic goals and objectives for expanding the frontiers of knowledge, capability, and opportunities in space in the most cost-effective, sustainable manner. BAAs allow for a competition of creative ideas without the agency being unnecessarily prescriptive about an approach or design.

NASA's long-term acquisition strategy for future lunar access will utilize FAR Part 12 commercial services-type contracts. Thus, while Phase One of Artemis will serve as a technology demonstration, NASA will purchase crewed landing capabilities as a service in the later phases of Artemis.

- b. **Why is NASA exempting the HLS BAA from normal FAR-based cost accounting standards?**

Answer: During the drafting of the HLS solicitation, the Contracting Officer determined that, based on market research and industry participation in the NextSTEP Appendix E contracts, the HLS competition was likely to have adequate price competition among offerors in accordance with the requirements of FAR 15.403-1(c)(1) such that NASA was prohibited from requiring certified cost and pricing data pursuant to FAR 15.403-1(b)(1). This expectation of adequate price competition was confirmed when NASA received HLS proposals from more than two responsible offerors and otherwise still expects to meet the remaining requirements of FAR 15.403-1(c)(1).

7. During the Space Shuttle program, Stennis housed a Main Propulsion Test Article (MPTA) that simulated the engine section of a Space Shuttle for ongoing testing and improvements. Is there merit in having a similar test article that simulates the SLS engine section that can be used to continually test and improve the propulsion systems on the rocket without putting future flight hardware at risk?

Answer: NASA and its industry partners are thoroughly testing the Space Launch System (SLS) in preparation for the uncrewed flight of Artemis I and subsequent crewed missions. The teams are focused on completing this work and staying on track for the Artemis III crewed mission to the Moon in 2024. The resources (work hours, hardware, funding) required to complete a Main Propulsion Test Article (MPTA) for the SLS engine section would have to be pulled from those being used to produce actual flight hardware, delaying the program unnecessarily.

- a. If so, how can we best leverage the test articles developed in the design and build of the first SLS rockets to help implement an SLS test article quickly at Stennis?

Answer: Please see response to Question #7, above.

8. Doug Cooke's op-ed in The Hill noted that the mission architecture with the highest likelihood of success is launching a fully integrated HLS on an SLS Block 1B to Lunar orbit, rather than launching the different pieces of the Lander separately on smaller rockets. Have the cost and risk of a disaggregated lander approach vs launching an integrated lander been analyzed?

Answer: Please see response to Question #2, above.

- a. Given the concerns about the disaggregated lander approach and mission assurance, would it be helpful to have an independent outside review of the best approach prior to committing the taxpayers to this more complex approach?

Answer: In addition to its own internal reviews, NASA already has many independent review groups engaged on the Artemis Program, including the NASA Advisory Council (NAC), Aerospace Safety Advisory Panel (ASAP), Users' Advisory Group (UAG), the Government Accountability Office (GAO), and the NASA Office of the Inspector General (OIG), among others. NASA is capable of evaluating all HLS proposals it receives and determining the best approach to accomplishing the mission.

The Honorable Tom Graves
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
NASA's Proposal to Advance the Next Moon Landing by Four Years

1. Given the global relevance of hypersonic technologies, it is critical the U.S. establish and sustain supremacy in high-speed flight for civil, commercial, and national security applications. How can NASA best support and leverage increased private investments being made in advanced aeronautics, including hypersonic flight?

Answer: NASA is recognized as having a fundamental role in developing high-risk, precompetitive aerospace technologies for which there is not yet a profit rationale. Hypersonic flight and associated technologies comprise such a market. In established and emerging aviation markets, NASA's capabilities in computer simulation and ground and flight testing strongly position us to support industry's private investments in technology development. NASA's fundamental research capabilities become especially relevant for the unique problems encountered in the air-breathing hypersonic flight arena. NASA partners closely with the Department of Defense to advance hypersonic technologies for national security applications. In a similar way, NASA can leverage private investment and contribute expertise and data that could help industry and other government agencies, such as the FAA, develop new regulations and standards that would be necessary to allow potential high-speed civil or commercial vehicles to fly in the national airspace.

2. How can private sector investments in these technologies augment and amplify NASA's own investments?

Answer: Private sector technology investments can augment and amplify NASA's own investments by providing hardware that can be tested in NASA's facilities, allowing NASA to use data from these tests for validation of analysis tools (computational models and codes) and collaborating with our subject matter experts to develop improved test capabilities, analyses and/or technologies. These improved test capabilities, analyses, or technologies could then be used by the private sector for their development of future civil applications, and could also be leveraged by the Department of Defense for national security applications.

3. Is NASA at risk of losing knowledge and expertise in hypersonics given the aging workforce?

Answer: Like much of the aerospace industry, NASA is at risk of losing knowledge and expertise in hypersonics given the aging workforce. This risk is due in part because the large research and development (R&D) programs of the past (e.g., National Aerospace Plane (NASP), X-43C), in which that workforce gained its experience, are less prevalent today. The expertise gained by the more experienced staff through their hands-on work in design, ground testing, and flight testing can be 'passed on' to some extent to the next generation through published reports and storytelling.

4. If so, how is the agency working to mitigate this loss of talent? Is there any plan in place to train the next generation of experts in hypersonics?

Answer: NASA is working to mitigate this loss of talent by making use of the various hiring approaches available at the NASA Research Centers to bring in graduating students and other early career employees. These hiring approaches include permanent civil servants, project-based or term-hire civil servants, NASA Pathways interns, on-site contractors, and post-doctoral employees.

NASA's programs are also investing in academic outreach and university partnerships to help develop talent. NASA's Hypersonic Technology Project (HTP) designates a portion of its budget each year to academic outreach. This funding has annually brought dozens of university students, primarily at the undergraduate level, to NASA Research Centers for a spring, summer, or fall session to work alongside our hypersonic experts. In addition, HTP awards multi-year research grants to support students pursuing graduate degrees in hypersonics. These graduate students also perform some of their research at NASA facilities, working alongside NASA experts, to maximize collaboration and mutual learning.

NASA's University Innovation Project is also working with the Department of Defense to pursue a University Leadership Initiative (ULI) award for hypersonic research. ULI awards comprise research at a team of universities to solve multi-disciplinary challenges through focused, multi-year research initiatives. A ULI award for hypersonic research would help build a network of university research activities to develop talent across the spectrum of technical disciplines pertinent to hypersonic flight.

**U.S. House of Representatives
Committee on Appropriations
Subcommittee on Commerce, Justice, Science, and Related Agencies**

**Material for the Record
NASA's Proposal to Advance the Next Moon Landing by Four Years
Oct. 16, 2019**

Rep. Meng

Q: How long did it take to develop the Apollo lunar surface spacesuits?

A: NASA began preliminary design analysis for Apollo lunar suits in Houston in 1962 and study contracts were let with seven potential contractors by mid-1963. Three prototype suits were evaluated by NASA in 1965 leading to contract awards in September 1965 to ILC Dover for the space suit and Hamilton Standard for the life support backpack.

An April 1966 development review found that the suit design met the minimum flight criteria, but further work was needed to meet performance goals for lunar operations. The Apollo 1 fire in January 1967 prompted a significant redesign of the suit to make it safer and more fire resistant. This was completed in 1968 and the first A7L model spacesuit was used on Apollo 7 in October 1968. The experience on Apollo 7 led to changes in the suit for Apollo 8 in December 1968. Such development work continued on the suit throughout the next three years, with changes to the suit design being implemented on almost every mission. A major redesign took place in 1970-1971 based on experience with Apollo 11-14 on the Moon, and need to meet the requirements for longer lunar EVAs. This redesign was significant enough to redesignate the suits used on Apollo 15, 16, and 17 as A7LB models. This marked the completion of major development.

Rep. Kaptur

Q: How do the timelines and budgets for the 2028 vs. 2024 human lunar landing proposals compare?

A: The \$1.6 billion requested in the amendment to the President's FY 2020 Budget Request supports the acceleration of NASA's Artemis III mission from 2028 to 2024. The budget runout for this mission will be reflected in the President's FY 2021 Budget Request.

Rep. Kaptur

Q: Provide a list of the most difficult technologies and systems NASA faces in achieving success in this project?

A: The technologies NASA requires for Artemis III are understood. There are two types of risks inherent in carrying out ambitious human spaceflight programs: political and technical. Some of the most challenging technical risks for HLS are yet to be realized as we begin the process of awarding to partners and negotiating those contract proposals. The FY 2020 budget request reflected what we need to maintain a planned 2024 lunar landing, including margins needed to address future technical issues.

Without those resources that schedule may be compromised. The funding level requested was to help eliminate some of the major risks as soon as possible, so with this current appropriation we will need to determine how to manage those. Some of those technical risks to a 2024 lunar landing under current appropriations include expediting development and starting long-lead production of the Gateway Habitation and Logistics Outpost, human lunar lander elements, lunar surface suits, and lunar surface logistics; demonstrating the capability for lander, Gateway, and logistics elements to rendezvous and dock autonomously prior to the arrival of the lunar landing crew; and ensuring sufficient time for integrated system testing of the Orion, Gateway, human landing system, and lunar surface suits.

With our workforce and partners, we will retire the technical risk, but political risk remains a factor. NASA has the support of this Administration to take our next giant leap, but we need the additional resources requested in the President's Budget and support from Congress to make a human return to the Moon by 2024 a reality.

Rep. Serrano

Q: How has NASA spacesuit technology been applied to assist people with disabilities?

A: Please access the link below for "*Cooling Garments Find New Medical, Athletic, and Industrial Uses*":

https://spinoff.nasa.gov/Spinoff2017/hm_4.html

CLERK'S NOTE.—The following are answers to submitted questions for the subcommittee hearing "Understanding the Changing Climate System and the Role of Climate Research" which was held February 26, 2019.

The Honorable José E. Serrano
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
Understanding the Changing Climate System and the Role of Climate Research

1. During the Obama Administration, NOAA spent a serious amount of time and effort developing climate adaptation plans. What effort has been put into the implementation of those plans?

Answer: Section 3 of Executive Order 13783 revokes Executive Order 13653 of November 1, 2013, in which agencies were called on to develop or continue to develop, implement, and update comprehensive plans that integrate consideration of climate change into agency operations and overall mission objectives. As a result of Executive Order 13783, NOAA will no longer develop, implement, or provide updates on the Department of Commerce Climate Change Adaptation Strategy, which was last updated in June 2014.

2. The National Weather Service at NOAA does significant outreach as part of its Weather-Ready Nation initiative to protect human life and property from weather events. Given that the National Climate Assessment says that our adaptation efforts are nowhere near the scale necessary to avoid substantial damages to the U.S. economy and human health, shouldn't NOAA make similar outreach efforts to help reduce the long-term risks that communities face from climate change? Has NOAA or NASA partnered with local communities to understand their needs for information and long-term decision support tools related to climate change adaptation comparable to the National Weather Service's Impact-Based Decision Support Services?

Answer: NOAA conducts a number of activities that help communities and decision-makers reduce current and projected risks from extreme weather events and changing ocean conditions. For example, NOAA's National Integrated Drought Information System (NIDIS) works with stakeholders to provide decision makers with climate and drought information and tools to assess the potential impacts of drought, and to prepare for and mitigate the effects of drought. The NOAA Regional Integrated Science and Assessment (RISA) program supports scientists and experts that work with their communities to incorporate information about weather and climate extremes in ongoing local and regional planning, preparedness and economic development practices. NOAA manages and maintains the U.S. Climate Resilience Toolkit, numerous projects at NOAA Laboratories and Cooperative Institutes, the National Sea Grant College Programs, the National Centers for Environmental Prediction (NCEP) Climate Prediction Center, and the National Centers for Environmental Information, all of which provide climate resources and data for regional, state and local managers in a customer-oriented manner. The National Marine Fisheries Service and National Ocean Service provide and integrate climate information as a part of many of their activities, and are responsive to their communities' needs for climate information. Finally, it should be noted that the U.S. Department of the Interior operates eight regional Climate Adaptation Science Centers.

3. How do NASA and NOAA coordinate with the rest of the federal government, and also with other partners including international partners?

Answer: NOAA and NASA coordinate across a wide range of research activities and have a positive and productive working relationship. Regarding climate research, NOAA and NASA coordinate extensively via the U.S. Global Change Research Program, which coordinates the 13 federal agencies engaged in global change research. NOAA and NASA, for example, have helped lead a Climate Modeling Summit for the past five years, which has brought together leadership from the U.S. Climate Modeling Centers to coordinate activities and collaborate. The agencies coordinate with international partners via organizations like the World Meteorological Organization, of which the World Climate Research Programme is a component.

4. How does our investment in NASA help NOAA, and vice versa? Are we duplicating effort unnecessarily on this important issue of the changing climate?

Answer: The climate research activities across NASA and NOAA are highly complementary. NASA's research is driven by remote observations and particular Earth system research questions, while NOAA's research is driven by the agency's prediction and stewardship missions. These different missions result in a different, yet complementary array of research activities at the two agencies.

5. The OAR take there are risks from potential sources of material coming into the atmosphere we may need to monitor for, and better understand, such as volcanic eruptions, air and space traffic in the stratosphere, climate intervention, and changes in the earth system itself.

Please describe the atmospheric observations that NOAA and NASA currently carry out that are critical to measure these materials, what observations are at risk, and the need for an expansion to baseline critical dynamics like Earth's radiation budget and changes in stratospheric chemistry going forward?

Answer: NOAA makes on-going, ground-based and *in situ* measurements of atmospheric composition—greenhouse gases, surface and stratospheric ozone, ozone-depleting gases, aerosols, and solar radiation at Earth's surface—all of which are essential for validating satellite data and developing atmospheric and Earth system models. Calibrated *in situ* measurements are the most accurate way to measure atmospheric composition, and are indispensable for research into areas such as ozone depletion and subseasonal to seasonal predictions. NOAA's Global Monitoring Division conducts ground based and *in situ* measurements. Expansion of this baseline stratospheric information would provide an improved comparison of the current and future condition of the stratosphere.

The Honorable Robert Aderholt
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
Understanding the Changing Climate System and the Role of Climate Research

GROUND-BASED VS. SATELLITE OBSERVATIONS

NOAA relies on an array of measurements from airborne and ground-based observations to detect climate trends and better understand our planet's processes.

1. Which do you consider to be the most reliable measurement to detect climate trends: ground-based or satellite observations? Do ground-based observations typically align with satellite observations?

Answer: Ground-based and satellite observations provide complementary datasets for detecting climate trends. Ground-based observations, which involve both *in situ* and remote observing strategies – extend much farther back in time than those from satellites, which are made solely remotely and started around 1979. NOAA ground-based observation networks provide the primary data for long-term climate records. NOAA satellites are designed to address weather forecasting requirements, but satellite data also contribute to climate data consistency and continuity. In turn, NOAA uses ground-based networks to ground-truth satellite measurements. Though ground and satellite datasets measure different characteristics of the land, atmosphere, ocean, and cryosphere, they do show consistent climate patterns and trends. Both observing systems are reliable and provide essential observations for monitoring climate trends.

2. What are some drawbacks of ground-based observations?

Answer: All observing systems have strengths and weaknesses. Ground-based sensors provide nearly continuous data in time. The data are highly reliable and calibrated, but only for those fixed points on Earth, and in some areas, these points can be far apart. Ground-based observations are restricted to the land surface, and while ocean observing networks provide some coverage over bodies of water, it is sparser than data over land. Satellites, on the other hand, provide measurements globally but cannot measure all global points continuously in time. Further, they need to be validated with ground-based observations. In practice, ground- and satellite-based measurements are used in a complementary fashion that leverages the advantages of each observation type. Understanding climate requires an optimal combination of both *in situ* observations and remote sensing.

3. Are scientists able to subjectively decide which of the measurements should be rejected or utilized in NOAA climate analyses and models?

Answer: Scientists apply rigorous, objective quality control and quality assurance measures, which have been subject to peer-review in producing analyses and model-observations comparisons. Data are not removed subjectively for use in NOAA climate analyses and models.

4. How does NOAA account for the fact that our latest models sometimes fail tests against observations?

Answer: Independent assessments of NOAA's climate models routinely report that they are among the best performing in the world. Climate models are the best available tool to help us understand how the climate might change in the future, but even the best models still involve limitations. These include relatively coarse spatial resolution, the use of physics packages that only approximately represent real atmospheric processes based on current understanding and the coarse spatial resolution allowable for running such packages in today's models, and uncertainties in model projection of future trends based on the socio-economic-technology scenarios specified throughout time as the model projection is made. Model-simulated results may vary from available observations, but such comparisons help us better understand uncertainties and improve the model. NOAA supports and sustains independent evaluation of our models as well as supporting further research focused on resolving the uncertainties in modeling. The agency makes data from its model simulations available to the public and accessible online at <https://data1.gfdl.noaa.gov/> and at the Coupled Model Intercomparison Project at <https://esgdata.gfdl.noaa.gov/search/cmip6-gfdl/>. This data access allows independent analyses by experts from other institutions.

WILDFIRE SIZE AND FREQUENCY

Scientists attribute the recent increase in fire frequency and size in the western United States to, among other things, the rise of global temperatures.

5. What are some of the factors you have identified that help predict wildfire vulnerability?

Answer: NOAA tracks and predicts several weather factors that help to predict conditions that could lead to fires affecting communities. These factors include certain types of phenomena that generate Santa Ana winds, extended dry periods of weather, drought intensity and length, and any other events leading to high winds and low humidity. NOAA identifies critical weather patterns that lead to potential extreme fire behavior.

6. How much data do you incorporate to take into account forest management practices which do not include enough efforts to prevent or slow fires?

Answer: NOAA does not independently predict fire behavior. In addition, NOAA does not actively manage national forests or public lands. Instead, NOAA works cooperatively with land management agencies to help them in their mission of protecting public lands. Fire management policies are independent of predicted weather or climate conditions. However, accurate weather prediction greatly enhances our partners' ability to manage fires and perform prescribed burns.

The Honorable Matthew Cartwright
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
Understanding the Changing Climate System and the Role of Climate Research

1. Does the NCA represent our foremost experts' most accurate estimates of our climate future?

Answer: The 4th National Climate Assessment (NCA4) was written by more than 500 prominent and diverse experts from over sixty countries, who assessed approximately 10,000 pieces of published literature, which is based on millions of physical observations of the earth. It represents a comprehensive assessment of the available literature.

2. Recently, White House Press Secretary Sarah Sanders described the NCA as "the most extreme version and it's not based on facts." Is this description an accurate representation of the NCA which NOAA signed off on?

Answer: Please see the response to question 3 below.

3. The NCA is based on several climate scenarios. According to Chapter 1 of the NCA, the "current trends in annual greenhouse gas emissions, globally, are consistent with RCP8.5" which is the scenario with the highest emissions. All other scenarios assume a reduction in greenhouse gas emissions compared with recent trends. During the February 26, 2019 hearing, Dr. Jacobs of NOAA stated that the climate change scenarios in the NCA are based on "extremes." Please explain what would lead Dr. Jacobs to conclude that the NCA climate scenarios are extreme, a statement which appears to contradict the NCA which NOAA signed off on.

Answer: The representative concentration pathways (RCP), overseen by the Integrated Assessment Modelling Consortium and developed independently by different researchers, range from RCP 2.6 to RCP 8.5, with RCP 8.5 functioning as an extreme scenario. RCP 8.5 includes several important assumptions, including high population growth rates and relatively less technological innovation despite a growing global economy. NCA4 presented its results based on only two of the scenarios, RCP 4.5 and RCP 8.5; however, the summary of findings and other statements in NCA4 were not specific as to which scenario was being discussed. There is a concern that many of the impacts at the projected timescales could only be achieved under RCP 8.5, and without identifying which specific impacts are associated with which scenario, it is difficult to effectively communicate risks to the public. In addition, the RCP scenarios follow a similar trajectory in the near future, without significant differences for several decades.

4. Has Dr. Jacobs ever met with anyone from the CO2 coalition or had conversations with anyone associated with this group about the plans for a climate working group?

- a. *If YES:* Does NOAA believe they represent a reasonable view on climate change that is consistent with the NCA and the work of NOAA scientists?
- b. *If No:* Does NOAA think they should be involved in the new climate working group?

Answer: No, Dr. Jacobs has not met with this group. NOAA is not familiar with the new climate working group that is referenced.

5. Has the NCA undergone rigorous independent and adversarial scientific peer review?

Answer: Yes. The NCA review process is described in NCA4's Appendix 1, "Report Development Process," which can be accessed here: <https://nca2018.globalchange.gov/chapter/appendix-1/>.

6. What steps have NOAA taken to ensure that your climate scientists can do their work unhindered by political influence?

Answer: The Department of Commerce is committed to promoting scientific integrity within NOAA. NOAA has a strong Scientific Integrity Policy (NOAA Administrative Order NAO 202-735D) that provides best practices to promote a continuing culture of scientific excellence and integrity.

7. Given the devastating storms America has experienced this past year, it would seem astute to share actionable data on climate change's effects with federal, state, and local groups. As mentioned in Dr. Jacob's testimony, NOAA collects and analyzes vast amounts of actionable data. However, in December of 2018, the Associated Press reported that NOAA's current chief Administrator has never briefed President Trump on climate change. Under President Obama, the NOAA chief Jane Lubchenco briefed the president every few months. Who is the most senior official in the White House Dr. Jacobs has spoken to regarding climate change and how regular is this communication?

Answer: Dr. Jacobs speaks regularly with Dr. Kelvin Droegemeier, Director of the White House Office of Science and Technology Policy and other White House officials about NOAA's science mission, including its climate science programs.

8. In 2014, the White House Office of Science & Technology Policy (OSTP), in partnership with an interagency working group that included NOAA, launched a new Climate Education and Literacy Initiative to help connect American students and citizens with the best-available, science-based information about climate change. How has NOAA continued this initiative and its goals under the current administration?

Answer: NOAA education programs and partners work to advance NOAA's mission through education, see NOAA Education's most recent Accomplishments report.¹ These Accomplishments reports cover all NOAA-related topics, including climate. For example,

¹ <https://www.noaa.gov/office-education/noaa-education-council/accomplishments>

NOAA's Climate Program Office maintains the Climate.gov portal, which provides teachers, educators, and students with a section called "Teaching Climate." NOAA's Climate Program Office also continues to curate the Climate Literacy and Energy Awareness Network (CLEAN) Collection, an award winning climate education program. Additionally, the NOAA Office of Education provides Environmental Literacy grants that have focused on Education for Community Resilience.

9. In 2014, under NOAA and NASA's leadership, the Obama Administration launched climate.data.gov — a climate-focused section of data.gov. Climate.Data.Gov featured datasets, web services, and tools to help communities prepare for extreme weather events. While other sections of Data.Gov have continued to be updated, the climate section has not been updated since President Trump took office. Does NOAA plan on reviving Climate.Data.Gov?

Answer: General Services Administration (GSA) is the lead agency for managing and maintaining climate.data.gov, with technical support from NASA. The climate-related data services and metadata that NOAA provided remain viable and accessible via the climate.data.gov catalog.

10. Another critical resource which now appears nonoperational is the U.S. Climate Resilience Toolkit. This toolkit was specifically designed to assist people in finding and utilizing tools to build climate resilience. It was last updated in 2015. Does NOAA plan on reviving the U.S. Climate Resilience Toolkit?

Answer: NOAA continues to maintain and update the U.S. Climate Resilience Toolkit and is upgrading the Toolkit's software and preparing to migrate the site to a new cloud-based platform, both of which will improve the Toolkit's responsiveness to users and ability to evolve into the future. In 2018, the Toolkit website received over 1.3 million visits, a 14.5 percent increase over 2017. In addition, the Toolkit team actively participates in training sessions all over the country to help people (e.g., municipal planners, resource and facility managers, utilities and businesses) find and use science data and information they need to build resilience to extreme events and climate-related hazards.

11. States in every region of the nation have experienced unprecedented storms and calamitous extreme weather events. These events threaten the health of our economy and the health of our communities. New York, New Orleans, and Miami are already making extensive infrastructure investments to account for sea level rise and the frequency of dangerous storms. Chapter 11 of the NCA says that "Recent extreme weather events reveal the vulnerability of the built environment." What is the range of infrastructure costs we may accrue due to damage wrought by climate change over the next decade?

Answer: It is not within NOAA's purview or expertise to assess infrastructure costs, and estimating impacts from climate change, particularly in monetary terms, contains uncertainty. The 4th National Climate Assessment (NCA4) highlights a number of recent analyses that have estimated potential damages to various infrastructure, in monetary terms, of projected climate change. Chapter 29 of NCA4, for example, highlights the following estimated damages towards

the end of this century under the higher emissions scenario (RCP 8.5): coastal property (\$118 billion/year); roads (\$20 billion/year); urban damage (\$6 billion/year); rail (\$6 billion/year); bridges (\$1 billion/year); Alaska infrastructure (\$174 million/year). Chapter 29 further shows the extent to which these damages could be avoided under the lower emissions scenario (RCP 4.5). It is important to put into perspective that the U.S. economy is projected to grow from \$20 trillion today to \$80 trillion by 2100.

12. The NCA also states that “current infrastructure and building design standards do not take future climate trends into account.” Do we need to do more to help our standard setting organizations utilize forward looking climate data?

Answer: Standard-setting and planning organizations are well positioned to partner with climate science-producing entities such as NOAA to incorporate forward-looking climate information, and to provide tailored information products. NOAA can assist these organizations to find and use the latest climate projections and tools for visualizing them; and to understand the uncertainties inherent in climate modeling and downscaling techniques.

13. Given what the NCA reports, would you agree that the federal government needs to confront extreme weather events with improved coordination and preparation? Is there more work that can be done at the federal level, and can we improve interagency coordination?

Answer: Federal agency preparedness and response has improved significantly since Hurricane Katrina in 2005. Efforts such as America’s PrepareAthon, and NOAA’s Weather-Ready Nation initiative, have focused preparedness action down to the community level and across agencies. However, extreme weather events and the impacts they cause are very complex. Vulnerabilities exist in national infrastructure, coastal development, and water availability (too much/too little). These realities increase the need for greater preparedness, collaboration, and coordination across all federal agencies. To that end, NOAA participates on multiple federal interagency bodies focused on improving data sharing, collaboration, and coordination for extreme weather and other hazards. This includes more than a decade of co-leadership of the National Science and Technology Council’s (NSTC’s) Subcommittee on Disaster Reduction, which recently sunset, and now co-leading the NSTC’s new Subcommittee on Resilience Science and Technology. Extreme weather events impact all aspects of society and the economy. NOAA provides weather, water, and climate information to core government, emergency management, and media partners. Improved decision making by government officials, businesses, and individuals will minimize loss of life and property damage.

14. Sea Grant supports cutting-edge research focused on aquatic invasive species, harmful algal blooms, shoreline erosion, green stormwater infrastructure, flooding and hazard resilience, and the economic valuation of natural resources, among other things. The President’s budget last year zeroed out funding for Sea Grant. Could you describe the unique extreme weather resilience information and projects that that Sea Grant provides?

Answer: Sea Grant has numerous weather resilience and information projects including the Community Resilience Index tool, the Homeowner's Guide to Hazard Preparedness, and the Vulnerability, Consequences and Adaptation Planning Scenarios process. In addition, Sea Grant funds, extends, and educates key audiences on social science research on improving effectiveness and accessibility of severe weather advisories and warnings offered by the National Weather Service (NWS) and partners. Sea Grant's research and education efforts have led to numerous adjustments in risk communication efforts by the NWS and partners.

15. How is NOAA planning on ensuring that these projects and data, which contribute to our assessment of natural resources, hazard resilience, and stormwater infrastructure continue to be implemented and collected?

Answer: NOAA will continue to provide data, technical assistance and policy coordination support to communities that are at risk from increasing sea levels and extreme weather events.

CLERK'S NOTE.—The following are answers to submitted questions for the subcommittee hearing "Executive Office for Immigration Review" which was held March 3, 2019.

The Honorable José E. Serrano
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record

Immigration Judge Hiring

1. You have recently streamlined the hiring process for immigration judges. While I fully support adding judges and reducing the backlog, I am concerned that we are not getting fair and impartial judges. **Of the Judges hired under the new streamlined process, what percentage are former attorneys of the Department of Homeland Security? What percentage are from public interest law or private immigration practice?**

ANSWER: The Executive Office for Immigration Review (EOIR) does not currently track prior vocational experiences of immigration judges ("IJ" or "IJs"), and most IJs previously worked for multiple legal employers. The professional biographies of IJs hired since 2013 are available on EOIR's website.

2. **When the current Administration began, were there any outstanding job offers for Immigration Judges from the previous Administration? Were any of these offers withdrawn? If so, how many?**

ANSWER: Sixty-three individuals who were made tentative offers of a position as an immigration judge prior to January 20, 2017, received an appointment and entered on duty after that date. Eight tentative offers of a position as an IJ made prior to January 20, 2017, were rescinded subsequent to that date. Six tentative offers of a position as an IJ made after January 20, 2017, have also been rescinded.

Varick Street Courthouse

3. I have a great deal of concern about what is happening at the Immigration Court in Manhattan. As I understand it, all ICE detainees are unable to access the Varick Street courthouse and are being forced to conduct their immigration proceedings over video teleconference. **Who made the decision to implement this arrangement? Was it ICE or EOIR? Is this a temporary arrangement? Or do you expect it to continue indefinitely?**

ANSWER: The use of video conferencing for detained cases at the Varick Street Immigration Court is currently the subject of active litigation, and it would be inappropriate to comment further while that litigation is pending.

4. **Can I get a commitment from you to work with ICE to try and get this resolved so that in-person hearings can continue?**

ANSWER: As the Department of Homeland Security (DHS) maintains responsibility for security and logistics in its detention space where immigration courts are located, EOIR respectfully defers to DHS regarding any future plans for detained hearings at the Varick Street facility. Otherwise, as this issue remains in active litigation, it would be inappropriate to comment further.

5. **My understanding is that New York's immigration courts previously had dedicated juvenile dockets with dedicated judges. This allowed city agencies to assist with obtaining counsel and providing health and educational resources for unaccompanied minors. The current ad hoc system makes it difficult to coordinate services- why was the change made?**

ANSWER: EOIR does not have an ad hoc system for juvenile cases. Juvenile dockets are consolidated so that all cases are heard on consecutive days at the end of the month. This scheduling format ensures that all juvenile cases are heard on a consistent, repeatable schedule, which should better enable city agencies, pro bono providers, and other interested parties in their planning and provision of services. The immigration courts in New York City continue to have dedicated juvenile dockets with dedicated IJs who consistently hear cases on the juvenile dockets.

Family Separation

6. Previous Administrations had proposed funding for the hiring of attorneys to represent unaccompanied minor children in immigration proceedings. At the time, I believe the proposal was widely supported by immigration attorneys and judges. **Does EOIR have an objection to the Congress funding such a program?**

ANSWER: Such funding may be inconsistent with Section 292 of the Immigration and Nationality Act, which makes it clear that aliens in removal hearings are not entitled to Government-funded attorney representation. Further, there may be potential questions that the agency would need to explore further regarding the propriety of EOIR funding both the immigration judge and a representative of a party to the same proceeding over which the judge is presiding. We note, however, that approximately two-thirds of all unaccompanied alien child (UAC) cases in immigration proceedings have representation, and nearly eighty percent of UAC cases pending for over one year have representation. Additionally, eighty-five percent of asylum cases have representation. Otherwise, the issue of whether UAC should be provided representation at government expense remains in active litigation, and it would be inappropriate to comment further.

2019 Shutdown Impacts

7. **What is the plan for ensuring all respondents receive notifications of the changes of venue they sought before the shutdown took effect, including new hearing dates, and other changes to their hearings?**

ANSWER: Immigration courts provide notice to both parties in accordance with applicable law regarding any changes of venue or rescheduling of hearings.

8. **What will the courts do to ensure there are not unnecessary orders of removal in absentia because of the lack of coordination?**

ANSWER: The requirements for the issuance of an *in absentia* order of removal are established by the Immigration and Nationality Act. Immigration judges determine whether the issuance of an *in absentia* removal order is appropriate based on the applicable law and the facts of each individual case.

Docket Adjustments

9. **Under both this Administration and the previous one, the docket has been re-shuffled. Has EOIR performed an analysis of the impact these reshufflings have had on the backlog and case completion numbers?**

ANSWER: EOIR has not performed a quantitative analysis regarding the broad docket reshuffling that occurred under the prior Administration, though there is strong qualitative evidence that it contributed to increased case processing times and decreased case completions. EOIR has not had a policy of docket reshuffling under the current Administration. Instead, EOIR has prioritized cases as appropriate, targeted certain categories of cases for expedited completion consistent with expectations under the law, and generally emphasized the importance of completing all cases in a timely manner consistent with due process. As a result, EOIR has completed 161,981 cases so far in FY 2019 as of May 31, which is more than it completed for the entire year in each of FYs 2013, 2014, 2015, and 2016, and it is already the third-highest single-year case completion total in the agency's history.

Space Requirements

10. **What are your plans to acquire new space in fiscal year 2020? Are you looking at GSA or other options?**

ANSWER: For non-detained courtrooms, EOIR is currently planning to open 17 new courtrooms before the end of FY 2019. In FY 2020, EOIR is on schedule to open 47 additional courtrooms with another 34 scheduled for early FY 2021. EOIR is working

closely with the General Services Administration (GSA) to expand current space as well as to pursue new space in both federal buildings and leased locations. For detained courtrooms, EOIR is dependent on DHS for any space expansion in detention facilities.

11. **What is the total square footage that needs to be acquired to accommodate all planned EOIR judges and staff, and does EOIR have a long-term facilities plan to accomplish this? If not, is one being developed?**

ANSWER: Incorporated within the budget request for each IJ and supporting staff is the funding necessary to acquire the necessary space for those employees. At this time, EOIR does not have additional vacant space. The Consolidated Appropriations Act, 2019, P.L. 116-6, provided funding to hire 534 IJs and the agency has requested an additional 100 IJs in the FY 2020 President's Budget for a total of 634 IJs. Counting the courtrooms referenced above and current courtrooms, EOIR expects to have 526 courtrooms available by the end of FY 2020. EOIR also has been working with GSA on long-range planning to acquire an additional 108 courtrooms in FY 2021, which would bring the total number of courtrooms to 634, consistent with the FY 2020 President's Budget.

The Honorable Grace Meng
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record

Issuance of Notice to Appear (NTA) Containing Fake Hearing Dates

1. Following the Supreme Court's decision in *Pereira v. Sessions*, which said that all NTAs in immigration court must include a date, time, and location, EOIR knowingly began to provide DHS components with artificial hearing dates to circumvent these requirements. Hundreds of immigrants on October 31, 2018 and over a thousand immigrants on January 31, 2019 showed up to immigration courts nationwide with NTAs containing fake hearing dates. **What steps have been taken to remedy incorrect NTAs and to provide proper notice to affected individuals? What is the current status of such cases?**

ANSWER: The initiation of removal proceedings generally involves two steps. First, a component of the Department of Homeland Security (DHS) (*i.e.*, U.S. Customs and Border Protection (CBP), U.S. Citizenship and Immigration Services (USCIS), or U.S. Immigration and Customs Enforcement (ICE)) serves an individual with a Notice to Appear (NTA) alleging that person's removability from the United States. Second, DHS files that NTA with an immigration court. Jurisdiction with the court does not vest until the NTA is filed pursuant to 8 C.F.R. § 1003.14(a). Consequently, although DHS may serve the NTA to an individual with a time and date for a hearing on it, the immigration court does not actually acquire jurisdiction—and, thus, the case is not actually “scheduled” and no record of proceedings exists—until DHS files the NTA with the court. Accordingly, although an individual may believe that his or her case has been scheduled for a hearing at the time and date indicated on the NTA and may appear for that hearing, that hearing cannot occur if the NTA has not also been filed with the immigration court.

Prior to the Supreme Court's decision in *Pereira v. Sessions*, 138 S. Ct. 2105 (2018), most—though not all—NTAs issued by DHS for aliens not in DHS custody did not specify the time and date of the initial hearing. In cases where the NTA did not specify the time and date of the initial hearing, the Executive Office for Immigration Review (EOIR) would schedule the initial hearing after the NTA was filed and serve notice of the hearing on both parties, typically by mail. Although most NTAs did not specify the time and date of the initial hearing, DHS did specify it for some cases based on dates provided through EOIR's Interactive Scheduling System (ISS). In those cases, DHS would specify the date, serve the alien, and then later file the NTA. If the NTA were filed prior to the date of the scheduled hearing, EOIR would process the NTA and either go forward with the hearing as scheduled or reschedule the case and issue another hearing notice which would be served on both parties. If the NTA was not filed prior to the scheduled hearing date, the case would not proceed and would be classified as a “failure to prosecute.” Only a limited number of DHS employees had access to ISS to avoid any instances of docket manipulation or overload. In *Pereira*, the Supreme Court held that an NTA which did not specify the time and date of the initial hearing was not an NTA that would stop the accrual of continuous physical presence for purposes of a particular application for relief. Consequently, DHS determined that it should specify the time and date of the initial hearing for all NTAs, which required expanding their access to ISS. Expanding this access and updating ISS takes time, so in the interim, EOIR provided dates directly to DHS to use on the NTAs. Some of those NTAs,

however, were not filed with the court in time to be processed in advance of the hearing date, leading to confusion. The hearing dates were not fake, but the cases could not proceed because the necessary documents were not timely filed with the immigration courts.

On December 21, 2018, EOIR announced that it would no longer provide dates directly to DHS after January 31, 2019, and that DHS should use ISS if it intended to specify the time and date of the initial hearing on the NTA. EOIR was prepared to address the dockets set for January 31 based on DHS filings and to process or reschedule cases as needed, with sufficient time to notify respondents of any changes in the hearing date; however, EOIR could not work on non-detained cases during the government shutdown that ran until January 25. Reopening on January 28—combined with weather closures and delays that week—did not provide it with enough time to process the new cases filed by DHS or to mail new notices of hearing to reach respondents with hearings scheduled for January 31.

Going forward, DHS is expected to use ISS, allowing EOIR to know ahead of time which cases have been scheduled and to plan accordingly, including by sending out notices of any rescheduled cases in advance of the hearing date. Thus, EOIR does not expect any reoccurrences of this situation.

2. **What is being done to prevent the re-occurrence of this situation, which poses significant hardships for immigrants and their legal cases?**

ANSWER: Please see the answer to Question 1.

3. **How many cases has DOJ identified to have been affected by the issuance of NTAs containing “fake” hearing dates?**

ANSWER: Please see the answer to Question 1. Because the hearing dates were not “fake,” EOIR has not tracked these cases as an identifiable cohort. Any case in which DHS does not timely file the Notice to Appear is handled in accordance with EOIR Policy Memorandum (PM) 19-08, available at <https://www.justice.gov/eoir/file/1122771/download>

4. I am hearing from immigration attorneys that March 4th, just 3 days ago, was a dummy date given to people to report to immigration court in Kansas City. People that live 7-8 hours away reported to court with their children, but were told that their NTAs weren't on file with the court. **Are dummy hearing dates still being issued?**

ANSWER: EOIR is no longer providing dates to DHS for initial hearings for non-detained cases in accordance with PM 19-08. As further outlined in PM 19-08, attorneys for respondents who have been served a Notice to Appear with a specified hearing date are encouraged to contact EOIR or DHS prior to that date if no information is found in EOIR's Automated Case Hotline about the hearing. EOIR respectfully defers to DHS for any additional information regarding dates that DHS places on Notices to Appear.

Migration Protection Protocols (MPP), also known as the Remain in Mexico (RIM) Plan

5. On February 25th, AP News reported that 112 people had been subject to the Migration Protection Protocols (MPP), otherwise known as the Remain in Mexico (RIM) plan, which requires asylum seekers to remain in Mexico as they await the adjudication of their asylum application. **How is EOIR facilitating access to counsel for individuals awaiting adjudication of their asylum claims?**

ANSWER: EOIR adheres to the relevant law regarding counsel in immigration proceedings, including the provision of an advisal of the right to counsel at no expense to the government to all aliens in proceedings. Otherwise, the MPP program is currently the subject of active litigation, and it would be inappropriate to comment further on MPP while that litigation is pending.

6. **Have individuals subjected to this plan been provided with Notices to Appear (NTA) that comply with notice requirements affirmed by the Supreme Court in *Pereira*? That is, do the NTA's have the exact date, time, and location that the individual's court hearing is scheduled for?**

ANSWER: Both the MPP program and the scope of the Supreme Court's decision in *Pereira* are in ongoing litigation. Accordingly, it would be inappropriate to comment further on either issue.

7. **Has EOIR establish a target timeframe for these adjudications? What timeframe does EOIR consider reasonable for these cases?**

ANSWER: EOIR's case processing goals for all cases are available at <https://www.justice.gov/eoir/page/file/1026721/download>

8. **How many immigration judges will be assigned to hear MPP cases? Where will these judges be located?**

ANSWER: MPP cases are currently being heard at the immigration courts in San Diego and El Paso. Any immigration judge at those courts may hear MPP cases.

9. **Has EOIR determined how much the implementation of this program will cost the agency?**

ANSWER: There is no apparent cost to EOIR associated with MPP, as the aliens subject to MPP would have been placed in EOIR proceedings even if MPP had not been implemented.

**The Honorable Marcy Kaptur
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record**

1. I represent Cleveland, which has an immigration court. There is a vacant position for a chief immigration judge and as a result, it makes it much more difficult for the local advocacy community to communicate with the court. **What are your intentions to fill the chief judge position in Cleveland?**

ANSWER: The Assistant Chief Immigration Judge for Cleveland entered on duty April 15, 2019, and will work at the Cleveland Immigration Court once he completes training.

2. With the court docket backlog doubling since 2014 at the Cleveland Immigration Court, and growing from 5,000 to 10,000, I am particularly worried about the slowness in filling additional immigration judge positions. **When will the sixth position in Cleveland be filled?**

ANSWER: The sixth immigration judge entered on duty April 15, 2019, and will work at the Cleveland Immigration Court once she completes training.

3. I am concerned about staffing of the Legal Orientation Program. Underfunding access programs appears an intentional effort to starve communities that rely on LOP for claimants to navigate the court system. With the hundreds of thousands of cases backlogged, the legal education programs are crucial for efficient operating of the program. **Is understaffing of the Office of Legal Access Programs an intentional effort to starve the courts and our communities of needed resources to facilitate faster removal of people that have viable immigration claims?**

ANSWER: EOIR staffing decisions are based on operational need and not on any issues listed in the question.

4. Even though there are open positions, EOIR is refusing to backfill open positions with the legal access program. The legal access programs make the courts work and run more efficiency. When claimants understand the basic rules of the road, there is less need for continuances and more chance that the law will be upheld. **How have staff levels in legal access programs shifted over the last two years? What are your plans to backfill positions that are currently open due to attrition?**

ANSWER: Staffing levels in the Executive Office for Immigration Review (EOIR) Office of Legal Access Programs (OLAP) have not shifted appreciably since FY 2017 and were sufficient to allow one of its attorneys to detail to another agency from 2017 to 2018. EOIR has multiple vacancies across all of its offices, including the Office of the Chief Immigration

Judge, the Board of Immigration Appeals, the Office of the General Counsel, the Office of Administration, and OLAP, and those positions will be filled according to operational need.

5. While the agency has taken an aggressive approach to filling honors attorney positions at EOIR, you have not attempted to fill positions at the Office of Legal Access Programs. **Is this a deliberate attempt to starve legal access of needed staffing to ensure litigants cannot adequately exercise their rights?**

ANSWER: Please see the answer to Question 3. Additionally, immigration judges ensure that due process and the rights of respondents are respected in all immigration proceedings.

6. **With the elimination of the Assistant Chief Immigration Judge position that investigated and took action on reports of temperament concerns with Immigration Judges, who is investigating these concerns and what is the process?**

ANSWER: EOIR's process for handling complaints against its adjudicators is available at <https://www.justice.gov/eoir/page/file/1100946/download>

7. In recent postings for OCAHO positions, EOIR indicated that it plans to utilize OCAHO judges for trial level cases with expertise in Immigration and removal proceedings outside the scope of their position as an OCAHO judge. Specifically, the posting said: "In addition to performing the duties described above, the ALJ is also qualified to conduct, and may be assigned to conduct the following proceedings as an immigration judge: removal, discretionary relief, rescission of adjustment status, claims of persecution, stays of removal, and bond and detention. In accordance with section 101(b)(4) of the Immigration and Nationality Act (Act), the incumbent is an attorney appointed by the Attorney General as an administrative judge who is qualified to conduct specified classes of proceedings, including removal proceedings under section 240 of the Act, and to preside at formal, quasi-judicial hearings to determine the issues arising in exclusion, deportation, and related proceedings. As such, the ALJ must have expert knowledge in immigration and employment law, including the relevant statutes and regulations, precedential decisions of the Board of Immigration Appeals, and decisions of Circuit Courts."

The statute envisions that ALJs at OCAHO focus in employment law. This type of cross posting has the potential for muddying the waters of your applicant pool and sending the wrong message to applicants about the priorities in filling positions for impartial subject matter experts. **When evaluating these open positions based on such an ambiguous job posting, does the administration prioritize asylum and removal proceedings or substantive employment law experience?**

ANSWER: An Office of the Chief Administrative Hearing Officer (OCAHO) Administrative Law Judge (ALJ), if appointed, is authorized by regulation to hear cases as a temporary immigration judge or a temporary member of the Board of Immigration Appeals, and an OCAHO ALJ has previously served as a temporary Board member. Consequently, an OCAHO ALJ presiding over removal proceedings is neither unusual nor beyond the scope of

the position. Beyond the minimum qualifications for an OCAHO ALJ position, EOIR prioritizes the seven Quality Ranking Factors listed below in evaluating applicants:

1. Ability to demonstrate the appropriate temperament to serve as a judge.
 2. Knowledge of immigration law, immigration-related illegal hiring and employment eligibility verification, employment discrimination, and/or labor law.
 3. Proven ability to manage cases, preferably in a high volume context.
 4. Experience managing a significant active caseload and the ability to render clear, thorough, and precise written decisions.
 5. Experience handling complex legal issues and/or complex litigation.
 6. Experience conducting administrative hearings.
 7. Knowledge of judicial practices and procedures, including the Federal Rules of Civil Procedure and the Federal Rules of Evidence.
8. In recent postings for BIA positions, EOIR indicated that it plans to utilize BIA judges for trial level cases that are normally outside the scope of their position as appellate judges. Specifically, the posting said “Although the majority of the Board Members’ time concerns hearing appeals, the incumbent is also qualified to conduct and may be assigned to conduct proceedings in the first instance as an immigration judge.” As an appellate judge, these types of cross postings present significant conflict of interest concerns. It also raises significant concerns about efforts simply to reassign BIA judges to a trial court if the Director is dissatisfied with the outcome of the decisions without regard to the quality of the legal analysis. **When evaluating BIA openings, does EOIR prioritize appellate or trial experience for these types of cross posted positions?**

ANSWER: Beyond the minimum qualifications for a Board member position, EOIR prioritizes the seven Quality Ranking Factors listed below in evaluating applicants:

1. Ability to demonstrate the appropriate temperament to serve as a Board Member.
 2. Knowledge of immigration laws and procedures.
 3. Proven ability to manage cases, preferably in a high volume context.
 4. Experience handling complex legal issues.
 5. Experience conducting administrative hearings, including proven ability or potential to serve as an effective decision-maker.
 6. Knowledge of judicial practices and procedures.
 7. Excellent analytical, decision-making, and writing abilities.
9. **What steps has EOIR taken to ensure cross posted positions avoid conflicts of interest. Also outline steps BIA has taken to prevent judges being assigned to Immigration Judge dockets as retribution for opinions EOIR leadership disagrees with?**

ANSWER: All EOIR adjudicators are expected to abide by all applicable laws, Department of Justice policies, and EOIR’s Ethics and Professionalism Policies to avoid any conflicts of interest in adjudicating cases.

All Board members are appointed by the Attorney General and may hear immigration cases at the trial level, just as federal appellate judges may hear cases at the district court level. All Board members will be expected to hear cases at the immigration court level, and assignments will be made solely based on operational needs. EOIR unequivocally does not assign work as “retribution.”

The Honorable Robert Aderholt
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record

Performance Metrics

1. In October of 2018, EOIR implemented performance-based metrics as one additional component of a multidimensional performance review of immigration judges. In addition to the 700-case completion goal, there are other benchmarks to ensure timely decision issuance, timely motions adjudication, and a low remand rate. **Do you believe these performance metrics will have an impact on the current backlog?**

ANSWER: Yes. EOIR has already completed more cases through the first eight months of FY 2019—the first year that the measures have been in effect—than it completed for the entire year in each of FY 2013, 2014, 2015, and 2016, though the pending caseload continues to grow due to record numbers of new case filings by the Department of Homeland Security driven by continued influxes of illegal immigration. In conjunction with EOIR’s efforts to expand its adjudicatory capacity by hiring more immigration judges, however, these measures will ensure that productivity remains at a high enough level to address the backlog.

2. **These performance-based metrics don’t tell immigration judges how to rule on any particular case, correct? What do you say then to those who claim the metrics are “quotas” that will undermine decisional independence of immigration judges?**

ANSWER: The performance measures are not based on case outcomes and do not dictate how to rule in individual cases. The measures are not quotas. Quotas are typically fixed with no room for deviation, whereas in evaluating immigration judge performance with respect to the measures, the Executive Office for Immigration Review (EOIR) will take into account six discrete factors, plus a seventh catch-all factor, that may affect the judge’s ability to meet the measures and may account for any deviations.

Performance measures are neither novel nor unique to EOIR, almost every federal administrative adjudicatory body uses them, and federal courts have upheld similar measures on multiple occasions. Further, effective performance management involves cascading organizational goals from the organizational level down to the employees who accomplish the work to advance those goals. To that end, EOIR adjudicators have operated for years under statutory or regulatory deadlines for the completion of certain types of cases, including under deadlines set by the Immigration and Nationality Act (INA), the Government Performance and Results Act (GPRA) of 1993, and the GPRA Modernization Act of 2010. Historically, EOIR also utilized case completion measures for non-detained cases from FY 2002 to FY 2009. It eliminated those measures in FY 2010, leading to criticism by both the DOJ Office of Inspector General and the Government Accountability Office, both of whom recommended that EOIR reinstate goals for the completion of non-detained cases. In 2016 and 2017, the House Committee on Appropriations also directed EOIR to establish goals for the median length of adjudication of detained and non-detained cases. The performance measures represent the role of the immigration judges in meeting those goals. In short, the

use of performance measures at EOIR is not new, it reflects a broad consensus that such measures are a necessary accountability tool to ensure that a court is operating at peak efficiency, and it ensures that EOIR will fulfill its mission and adjudicate cases in service to the national interest.

Further, as a report prepared for the Administrative Conference of the United States (ACUS), an independent federal agency charged with convening expert representatives from the public and private sectors to recommend improvements to administrative process and procedure, has recognized, “case-processing goals can improve productivity and accountability.” All but 68 of 10,831 reported non-ALJ administrative adjudicators in the federal government are subject to performance appraisals; moreover, 81 percent of non-ALJ types in the federal government that receive performance appraisals are subject to case-processing goals, just as immigration judges are. EOIR’s other adjudicatory components, the BIA and OCAHO, are already subject to case processing goals and have been for several years. Even agencies which employ ALJs, such as the Social Security Administration, have utilized case processing metrics for over forty years which have been repeatedly upheld by multiple circuit courts of appeals. In short, performance measures like those for immigration judges are a common and effective tool for ensuring that administrative adjudicators render decisions in an expeditious manner consistent with due process.

3. What was the average completion rate prior to the implementation of the metrics?

ANSWER: EOIR has hired 193 immigration judges (IJs) since January 20, 2017, and has also expanded its corps of supervisory IJs. New immigration judges take time to build up efficiency completing cases, and supervisory IJs are not subject to the case completion goal. Consequently, EOIR has not tracked an average completion rate per IJ because the denominator fluctuates considerably depending on when the average is calculated. In June 2017, however, the Government Accountability Office (GAO) found that the average completion rate fell from 1,356 completions per IJ in FY 2006 to 807 per IJ in FY 2015.

4. How was the number 700 determined?

ANSWER: Like all of the performance measures, the case completion measure reflects a considered policy judgment regarding the efficiency that an experienced immigration judge working a regular schedule should reasonably be able to achieve. Similar measures are used for administrative adjudicators at other agencies, and the immigration courts themselves have operated under case completion goals for years. The immigration judge union determined in FY 2010 that an average immigration judge completed 1,500 cases per year. The GAO found that an average immigration judge in FY 2015 completed 807 cases per year. Consequently, the more modest 700 case completion performance measure is also in line with historical norms. More recently, in March 2019, the American Bar Association reaffirmed its recommendation that immigration judges should manage a caseload “roughly on par with the number of cases decided each year by judges in other federal administrative adjudicatory systems (around 700 cases annually).”

5. **What happens if an immigration judge does not meet that 700-case goal?**

ANSWER: The collective bargaining agreement (CBA) between EOIR and the immigration judge union calls for the consideration of six discrete factors, plus a seventh catch-all factor, that may affect a judge's ability to meet the performance measures, including the 700-case goal. EOIR will comply with all of its obligations under the CBA before assigning a performance rating to an IJ based on the measures.

CLERK'S NOTE.—The following are answers to submitted questions for the subcommittee hearing "Oversight of the 2020 Census Preparation" which was held April 30, 2019.

Questions for the record for Dr. Steven Dillingham, Director, Bureau of the Census regarding the hearing: "Oversight Hearing: 2020 Census Preparation"

**The Honorable José E. Serrano
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record**

1. **Assuming the citizenship question is ultimately included in the 2020 Census, will Census count individual(s) who self-respond, but elect to not answer the citizenship question on the 2020 Census form?**

Answer: The 2020 Census will not include a citizenship question. A complete and accurate census depends on the collection of quality data for every household. We will encourage all respondents to respond to every question on the 2020 Census. However, we recognize that with any survey or census, item non-response may occur. For the online questionnaire, we will include prompts if the respondent has failed to answer a question. Also, failure to answer questions on the census increases the likelihood of a follow-up visit by a census enumerator. After the total person counts have been established, missing item data will be imputed pursuant to well-established methods and procedures.

2. **The Census Bureau last published a 2020 Census life cycle cost estimate in December 2017. Does the Bureau intend to submit an updated life cycle cost estimate or an update on where the cost variances are since your last estimate? If so, when might we expect that?**

Answer: The Census Bureau has completed a revised 2020 Census Lifecycle Cost Estimate. The public-facing document, called the Executive Summary, Version 2.0, was released on June 10, 2019 and is posted on the Census Bureau's website at <https://www.census.gov/programs-surveys/decennial-census/2020-census/planning-management/planning-docs/cost-estimate.html>.

3. **Does the Census FY 2020 budget request provide for a best or worst case scenario? In other words – is there sufficient cushion in the budget for things that might go wrong?**

Answer:

The funding request for FY 2020 reflects the cost of conducting and achieving a complete and accurate 2020 Census. It includes approximately \$1.1 billion in contingency funding.

The prior Administration significantly underestimated the cost of successfully conducting the 2020 Census. Upon taking office Secretary Ross undertook a thorough analysis with Census Bureau and Department of Commerce staff to determine an

accurate budget for conducting a complete and accurate 2020 Census. That deep dive analysis led Secretary Ross to support the \$15.6 billion 2020 Census Life Cycle Cost Estimate (LCE), which was presented to Congress in 2017. The President's FY 2020 Budget Request is consistent with the 2020 Census LCE, with the exception that it does not include the unknown-unknown contingency funding related to a sensitivity analysis around a few major assumptions that are in the \$15.6 billion estimate. The FY 2020 Budget Request does, however, support the full \$14.1 billion estimated cost of the operations of the 2020 Census in the LCE, which itself includes approximately \$1.1 billion in contingency funding for known risks. The Census Bureau is confident the \$14.1 billion estimate will support a complete and accurate 2020 Census.

The Census Bureau will work closely with Department leadership and appropriations committees to continually track and assess the 2020 Census program's progress and needs. Secretary Ross has previously stated that should any unknown unknowns become known then he would work with the Administration and Congress to seek any additional funds needed at that time.

4. **How does Commerce intend to use the data provided by the Department of Homeland Security (DHS) for its Decennial operation?**

Answer: Title 13 of the United States Code instructs the Census Bureau to obtain administrative records to the maximum extent possible and when consistent with the statistics required. The use of the administrative records will result in producing citizen and non-citizen estimates for the voting age population at the block level. The Census Bureau is seeking data from DHS to supplement its existing administrative records and provide additional information on citizenship. The format of the data product is in development and is planned to be released by March 31, 2021.

In accordance with Title 13, all information obtained about individuals through administrative records will be used only to produce statistics and will be subject to the confidentiality provisions of Title 13. As a result, the Census Bureau is restricted from providing information to any entity that identifies an individual or otherwise violates Title 13 confidentiality provisions. Protecting confidentiality is not only a legal requirement, but also part of the culture of the Census Bureau. All employees take a strict lifetime oath of confidentiality. Anyone who violates that oath is subject to five years in prison and up to \$250,000 in fines, or both.

5. **Doesn't gathering citizenship information from DHS eliminate Commerce's need for a citizenship question on the 2020 Census form altogether?**

Answer: The 2020 Census will not include a citizenship question. Pursuant to Executive Order 13880, the Census Bureau will obtain citizenship information for the 2020 Decennial Census via administrative records.

6. **Have you engaged in previous partnerships with the Department of Homeland Security since January 2017? If so can you please detail them? Additionally, can you confirm in writing that information generated from the use of these records will not be shared with DHS or any other federal agency?**

Answer: The Census Bureau has worked with DHS to enhance the cybersecurity posture of its IT systems and to share security threat intelligence. This partnership with DHS on security is completely separate from requests to obtain data. DHS does not have access to any information protected by Title 13—including individual census questionnaire responses—through its collaboration with the Census Bureau on cybersecurity or through any other means.

Following the Secretary’s decision on March 26, 2018, the Census Bureau reached out to officials within the DHS to obtain citizenship data, and that work continues under the Executive Order 13880. Throughout these negotiations, both the Census Bureau and DHS have underscored their shared commitment to ensuring that privacy and confidentiality is protected, and the Administration’s overall commitment to adhere to Title 13 protections was clearly reiterated in the Executive Order. No information that identifies an individual or otherwise is inconsistent with Title 13 confidentiality provisions will be shared with DHS or any other federal agency. All information obtained from any agency or respondents will be used only to produce statistics. Protecting confidentiality is not only a legal requirement, but also part of the culture of the Census Bureau. All employees take a strict lifetime oath of confidentiality. Anyone who violates that oath is subject to five years in prison and up to \$250,000 in fines, or both.

7. **It appears as if Commerce is prioritizing Justice’s request for block-level data over the Census Bureau’s Constitutional responsibility to enumerate “all persons”, despite Justice not illustrating a true issue with non-citizens showing up at the polls. What is Census doing to maximize participation within all minority groups, especially those who may have been undercounted in 2010?**

Answer: The 2020 Census Community Partnership and Engagement Program will focus the efforts of approximately 1,500 partnership specialists to increase self-response and participation in communities that, for any reason, are hesitant to respond or will not respond. Partnership specialists will use existing networks, resources, and “trusted voices” to increase census participation in low response communities. Stakeholder Communication and Engagement activities include 2020 Census Program Management Reviews, National Advisory Committee (NAC) Meetings, NAC working groups that focus on 2020 operations for hard-to-count populations, Census Scientific Advisory Committee Meetings, and congressional briefings.

The Census Bureau also conducted a series of tribal consultations with federally and state-recognized tribes. In addition, the Census Bureau’s many presentations to various audiences about the 2020 Census Operational Design often lead to feedback, and recommendations pertaining to hard-to-count populations.

Furthermore, the 2020 Census will enable limited English-speaking individuals to respond to the census by providing response options and assistance in multiple languages. This represents a significant expansion compared to the 2010 Census. The 2020 Census will feature the most robust language program built for any census.

The language program for the 2020 Census can reach more than 99 percent of the population. In 2010, the Census Bureau provided the questionnaire and telephone assistance in five non-English languages. In 2020, we are expanding this support to cover 12 non-English languages for online and phone response. Printed and video language guides and glossaries are being produced in 59 non-English languages. In addition, the Census Bureau will provide templates of the language guides and glossaries so that partners in communities and from organizations representing those who speak languages not covered by the 59 languages will be able to create guides in additional languages. Also, we are recruiting aggressively to hire field staff with language skills. Of our more than 550,000 applicants so far, nearly 20 percent can speak a language other than English, representing more than 400 languages and dialects.

8. **What steps is the Bureau taking to ensure that the 2020 Census does not experience a high rate of non-interviews after its follow-up on non-responders is completed?**

Answer: To minimize non-interviews, the 2020 Nonresponse Followup operation will include an improved contact strategy. The contact strategy will cover the procedural and business rule changes for the entirety of the Nonresponse Followup operation, including case assignment and all phases of the operation from beginning to end. The contact strategy will involve three phases – Phase 1 (fully automated routing and assignment of cases with emphasis on making contact with all households early in the operation), Phase 2 (restricting assignments to high performing interviewers with an emphasis on successfully completing interviews with all households), and Phase 3, closeout (focusing on getting minimal information for households to achieve an orderly completion of the operation). With each of these three phases, we will implement more controls and restrictions on case assignments and management to ensure effective and efficient completion of the operation.

9. **How prepared is the Census to face a tight labor market next year in 2020 when it needs to ramp up its hiring to hundreds of thousands of temporary workers? How are you changing your recruitment and hiring strategies to adapt from what Census did in 2010?**

Answer: The emphasis will be on competitive and attractive pay rates, as well as an easy application process. It takes 30 minutes or less to apply online compared to an average two-hour application process in 2010. Job offers will be contingent upon applicants passing a background check (including fingerprinting).

The Census Bureau is employing multiple hiring strategies, such as developing partnerships with local organizations that can get the word out about census jobs and encouraging media covering census events to mention 2020 Census jobs. Census recruiters will attend community meetings and will set up recruiting booths at public events like job fairs, county fairs, bazaars, tribal pow wows and other public events. The Census Bureau will place public service announcements, in addition to paid job advertising, in regional and local mainstream and ethnic media, including social media. The Census Bureau is also leveraging traditional social media without public service announcements by posting about census jobs on Facebook, Instagram, and Twitter. At the same time, the Census Bureau is also recruiting through traditional communication methods like issuing national and local news releases announcing census jobs as well as distributing posters, flyers, and other promotional materials.

10. **Is Census looking to expand its hiring to legal permanent residents? And does the U.S. Census currently hire LPRs who qualify for employment as specified under current law?**

Answer: Yes, the Census Bureau anticipates there may be a need to hire non-citizens to serve as translators in limited circumstances. The Census Bureau has established a “translator” position for the 2020 Census to acquire the specific languages skills needed to facilitate enumeration and the Census Bureau. Consistent with existing employment and appropriations law, and as the translator position is a temporary, excepted service position, which exists solely for the purposes of conducting the 2020 Census, the Census Bureau may hire non-U.S. citizens for these positions. As a point of reference, during the 2010 Census, the Census Bureau hired approximately 3,500 non-citizens out of a total workforce of more than 700,000 temporary employees to assist with enumeration activities, representing less than 0.5% of the total temporary census workforce. The Census Bureau anticipates a similar percentage of non-citizens could be hired as translators during the 2020 Census.

11. **With all the different types of communities across the country, and with not everybody getting mail delivered to their house or having internet access, how can people be assured that in their neighborhood, the right 2020 Census strategy is being used, and how can they know that they won't be missed in the enumeration?**

Answer: Every household will have the option of responding online, by phone, or by mail. Nearly every household will receive an invitation to participate in the 2020 Census from either a postal worker or a census worker: 95 percent of households will receive their invitation in the mail and almost 5 percent will receive their invitation when a census taker drops it off. In the latter areas, the majority of households may not receive mail at their home's physical location, like households that use PO boxes or areas recently affected by natural disasters. Regardless of whether households receive an invitation or not, they can respond via the internet or phone without the unique census ID included in the invitation.

All households that have not yet responded after the third mailing will receive a paper questionnaire in the fourth mailing (approximately April 8 – April 16). About 20 percent of households in mailout areas will receive a paper questionnaire in the first mailing (the "Internet choice" mail cohort). Extensive data-driven research was undertaken to identify areas that should receive the paper questionnaire upfront. These areas included those with expected lower Internet usage, which would be more likely to benefit from an earlier paper questionnaire. The primary factor in this delineation was census tracts that have lower self-response rates, including lower Internet response, to the American Community Survey. Secondary factors are tracts that have relatively higher concentrations of people aged 65 or older, and tracts with low Internet subscribership. The Census Bureau plans to release this information (which areas will receive paper questionnaires upfront) publicly this fall so that local governments, partners, and other stakeholders can plan accordingly.

12. **We understand that for the 2020 Census, the Bureau is working with the Department of Homeland Security, among other Federal and industry partners, on cybersecurity issues. How is the Bureau working to incorporate DHS recommendations for the cybersecurity of its 52 systems? Is the Bureau doing everything the Department is recommending or suggesting related to the 2020 Census cybersecurity efforts? What remains to be done between now and the Census day?**

Answer: The Census Bureau is collaborating on a variety of efforts with DHS and industry partners to optimize the security posture of the Census Bureau for the 2020 Census. DHS has provided a variety of recommendations, as well as advice on best practices for the Bureau to consider in preparing for the 2020 Census. The Bureau has completed about 80% of the recommendations and continues work on remaining recommendations where feasible. The remaining work will help to enhance our network security posture and incident response capabilities.

13. **What is (are) the Bureau’s contingency plan(s) if the systems have to be offline because of performance or scalability issues, data breaches, or natural disasters? Do these plans address how long a system can be down without affecting Census operations? What is the backup plan if the key technologies (internet and mobile devices, for example) do not work during the 2020 Census?**

Answer: The Census Bureau is confident that our systems are able to handle user demand and remain resilient against cyber threats. The Bureau is deploying a variety of measures to mitigate the risk of a disruption of service for both off and on-premise systems. These measures address natural disaster scenarios, as well as any major data center disruptions. We are implementing redundancy into our systems architecture to ensure continuity of operations. Multiple cloud availability zones are located in different geographic areas. Additionally, the systems are designed to take advantage of dynamic scalability solutions provided by cloud vendors. Our operations continuity plan also ensures that the self-response modes of paper, telephone, and internet are able to serve as alternate means to collect survey data.

14. **Last August, GAO reported that the Bureau’s timeframe to perform security assessments for systems, in some instances, went from at least 6-8 weeks to about 5-8 days during the 2018 End-to-End Test. According to the GAO report, this resulted in systems being deployed before the security of all systems components were assessed. Given that there will be a total of 52 systems, what is the Bureau’s plan for completing security assessments for each system in a timely manner to successfully carry out the 2020 Census operations?**

Answer: All systems used in the 2018 End-to-End Test were thoroughly tested and received an Authority to Operate by the Chief Information Officer and the “business owner” in the program in advance of being used in the test. Fifty-two systems have been identified to be used to conduct the 2020 Census. Forty-three systems have received an authorization to operate. Three have a current authorization to operate but may require reauthorization before being used in the 2020 Census. One system does not require an authority to operate. And, five systems do not have authorization to operate, but will be authorized prior to being used in the 2020 Census.

15. **GAO recently reported that the Bureau had identified nearly 1,100 system security weaknesses that needed to be addressed. What is the status of the Bureau's efforts to address these weaknesses? What steps is the Bureau taking to ensure that these are addressed in a timely manner?**

Answer: Since GAO issued its report, the Census Bureau has addressed and closed most of the findings. The Census Bureau continuously monitors its security posture to stay ahead of cyber threats. Each month the security team scans systems for more than 100,000 potential vulnerabilities, with new items added each month. The Census Bureau prioritizes remediation of any high-risk findings within strict timelines to most effectively reduce threats and improve the security of the systems. Unlike most Federal organizations, the Census Bureau intentionally tracks more findings at a detailed level to better show progress and increase visibility for our own operational purposes and our oversight bodies.

16. **GAO has reported that the Bureau deployed systems during its 2018 End-to-End Test before the security of all system components were assessed. Given that the Bureau collects personal information on hundreds of millions of people in the United States, what concrete steps is the Bureau taking to ensure that these assessments are completed before systems are deployed, and that corrective actions are adequately addressed?**

Answer: The Census Bureau follows a risk management framework that requires all Census Bureau information systems to be assessed for their security and receive authorization prior to deployment. All systems used in the 2018 End-to-End Test were thoroughly tested and received an Authority to Operate in advance of being used in the test.

Complementing the Census Bureau's Risk Management Framework, an Operational Delivery (OD) framework structures and tracks the development, testing, security assessment, and deployment of all 2020 Census systems. This OD framework includes a schedule that integrates and staggers system deployment to efficiently and effectively deliver systems on time. The Census Bureau has embedded security assessments for all 2020 Census systems within the overall framework's schedule to ensure that systems are fully tested and meet all requirements for deployment in compliance with their scheduled OD. The Census Bureau is currently on track to meet this schedule. As the program works through the system development lifecycle, staff identifies system weaknesses early in the process, proactively address these weaknesses to reduce residual risk to a minimum, and tracks and remediates these risks through plans of action and milestones (POAM) documents.

17. **What is the Bureau's approach to making sure that cybersecurity risks related to systems are at an acceptable level before they are deployed? Does the Bureau have a risk threshold for 2020 Census systems? If not, why not? How does the Bureau determine the security corrective actions (i.e. plans of actions and milestones or POAMs) that will be accepted rather than addressed? What is the reason (e.g., schedule, cost, etc.) that these risks are accepted rather than addressed?**

Answer: As part of the Census Bureau's Risk Management Framework Methodology, the Census Bureau embeds security engineers early in the secure development lifecycle to support programs in the identification and implementation of security controls to improve the security posture of information systems prior to deployment. The Census Bureau conducts manual and automated assessments to determine the security and privacy risks of information systems and documents those risks in a risk evaluation memorandum which includes quantitative (e.g. risk scores) and qualitative information. The qualitative impact value in the memorandum represents the potential impact resulting from a compromise of the confidentiality, integrity, or availability of an information system, expressed as a value of low, moderate or high. This information is used by the authorizing official to determine if the level of risk is acceptable based on mission, business, and operational needs. The Census Bureau makes risk-informed authorization decisions by considering a range of quantitative and qualitative security information. Further, the decision to accept risk associated with a security control is made by authorizing officials and is based on a variety of factors, including but not limited to, financial cost, vendor or technical limitations, schedule constraints, and operational needs.

The Honorable Charlie Crist
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
Oversight Hearing: 2020 Census Preparation
April 30, 2019

- 1. Since disability is not asked on the census form, how will the Census Bureau conduct its outreach efforts to people with disabilities? And will studies be conducted to ensure that people with disabilities are not undercounted in the 2020 Census?**

Answer: The 2020 Census Community Partnership and Engagement Program is gearing up with a goal of signing up hundreds of thousands grass-roots organizations across the country to educate people about the census, motivate people to self-respond to the census, and foster cooperation with census takers. This will include outreach to people with disabilities. Through creative components from the communications campaign—such as those in paid advertising, promotional materials, and Statistics in Schools—people living with a disability will be able to see themselves as part of a diverse population. The 2020 Census National Partnership Program will reach people with disabilities on a national scale.

The 2020 Census communications contractor, VMLY&R (also known as Team Y&R), has about a dozen subcontractors that specialize in various areas of communications or outreach with various segments of the population, including people with disabilities. For example, one of the subcontractors is the District Communications Group, which lends its expertise in outreach to disabled service members and veterans. The Census Bureau is working to ensure that the 2020 Census provides an equivalent experience for everyone regardless of needs or disabilities. Reaching hard-to-count communities, including people with disabilities, is woven into the entire design of the 2020 Census. The partnership program has reached out to the American Association of People with Disabilities, Disabled American Veterans, Paralyzed Veterans of America, the National Association of the Deaf, and many others to encourage support for the 2020 Census. The Census Bureau is also leveraging other organizations and Federal agencies to conduct outreach to people with disabilities. Furthermore, the 2020 Census is developed to conform to Web Content Accessibility Guidelines (which includes compliance with Section 508 of the Rehabilitation Act). Additionally, 59 video and print language guides will be available online, including in American Sign Language, braille, and large print. Census Questionnaire Assistance will include a telecommunication device for the deaf.

- 2. Given the Administration’s decision to include a question regarding citizenship in the 2020 Census, the ongoing Supreme Court case, and increasing concern from minority and immigrant populations about being compromised by participating in the Census process, how much has the Census spent and how much does it plan to spend on media and outreach to educate and help further engage non-English speaking populations heading into the 2020 Census?**

Answer : The 2020 Census will not include a citizenship question. Pursuant to Executive Order 13880, the Census Bureau will obtain citizenship information for the 2020 Decennial Census via administrative records. Regarding efforts to educate and further engage non-English speaking populations, the focus of the communications contract is to educate and motivate the public to self-respond, preferably via the internet, with special emphasis on reaching and motivating the hard-to-count audiences to respond. This includes not only paid media, but also local/national partnerships, the Statistics in Schools program, earned media, social media, and events. The Census Bureau awarded the 2020 Census Integrated Communications Contract, with a ceiling of \$518 million and current value based on a budget of \$498 million, to VMLY&R. Team Y&R has 15 subcontractors that specialize in communications with various segments of the population, including non-English speaking populations. Some of the subcontractors include Culture ONE World, which has expertise in the Hispanic market, and TDW+Co, which has expertise in the Asian-American market. The Census Bureau is also investing about \$500 million in its national and local partnerships program and other communications efforts led internally by Census Bureau staff.

In addition, the Census Bureau and Team Y&R will be making timely, data-driven adjustments during the 2020 Census communications campaign execution. This process involves using feedback and data to shift advertising spending levels, message content, media venues, partnership efforts, and other components of the communications campaign to focus on geographies or audience segments with lower-than-expected response rates, and adjusting resources expended on areas with high response rates, thereby gaining efficiencies.

Furthermore, the 2020 Census will enable limited English-speaking individuals to respond to the census by providing response options as well as assistance in multiple languages. This represents a significant expansion compared to the 2010 Census. The 2020 Census will feature the most robust language program built for any census, with the ability to reach more than 99 percent of the population. In 2010, the Census Bureau provided the questionnaire and telephone assistance in five non-English languages. In 2020, we are expanding this support to cover 12 non-English languages for online and phone response. Advertising, partnership, and promotional materials, at a minimum, will be in the languages covered by the 12 response options. Printed and video language guides and glossaries are being produced in 59 non-English languages. In addition, the Census Bureau will provide templates of the language guides and glossaries so that partners in communities and from organizations representing those who speak languages not covered by the 59 languages will be able to create guides in additional languages.

The Honorable Marcy Kaptur
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record
2020 Census Preparation

1. **Non-response follow-up—I am concerned that a shift in focus to online data collection will leave out lower income and elderly communities in urban areas with lack of access to internet services. In my own district, we send our constituent correspondence in paper form as we know this is the preferred means of communications for my constituents.**

According to the GAO report, these new procedures and technologies have not been used extensively in earlier decennials and have not been fully tested. What extra steps is the Census Bureau taking to ensure thorough non-response follow up among already marginalized communities?

Answer: Every household will have the option of responding on a paper questionnaire by mail, over the phone, or online. About 20 percent of households in mailout areas will receive a paper questionnaire in the first mailing. Extensive data-driven research was undertaken to identify areas that should receive the paper questionnaire upfront. These areas included those with expected lower Internet usage, lower self-response rates, relatively higher concentrations of people age 65 or more, and areas with low Internet subscribership. All households in mailout areas that have not yet responded will receive paper questionnaires between April 8 and April 16, 2020.

The 2020 Census Community Partnership and Engagement Program will focus the efforts of approximately 1,500 partnership specialists to increase self-response and participation in communities who are hesitant to respond or who will not respond. Partnership specialists will use existing networks, resources, and “trusted voices” to increase census participation in low response communities. While most nonresponse follow-up cases receive a maximum of six attempts, cases in hard-to-count areas may receive more than six attempts to achieve a consistent response rate for all geographic areas. When a language barrier is encountered, efforts will be made to identify an enumerator who speaks the language of the respondents. The overarching strategy for hiring enumerators is to hire people who will work in the communities in which they live.

2. **I am concerned that Census response rates have consecutively decreased from 78% in 1970 to 63% in 2010. Indeed, the U.S. populace is becoming larger and more diverse. Meanwhile people of low economic means are very transient and experience more difficult in being counted. Greater outreach is desperately needed.**
 - a. **How is the Census Bureau engaging Congressional offices to leverage their extensive relationships to increase Census turnout? How can Congressional offices assist in strengthening these efforts?**

Answer: As Dr. Dillingham noted in his testimony, Congressional offices are essential partners for encouraging 2020 Census participation. Congressional offices can reinforce the Census Bureau’s messages about the importance of responding to the 2020 Census and about the safety of providing responses and the confidentiality of the data.

Dr. Dillingham also noted that the Census Bureau distributed a 2020 Census toolkit for congressional offices, which is available at <https://www2.census.gov/about/ocia/2020-census-congressional-toolkit.pdf>. This toolkit describes ways that congressional offices may collaborate with Census Bureau headquarters- and field-based staff on outreach and communications. The toolkit includes suggestions on how to launch state and local campaigns to raise awareness about the 2020 Census, information on hard-to-count populations, sample messages for public and media engagement, resources to help congressional offices respond to constituent inquiries, and fact sheets on topics of interest to Congress and the public. We will continue soliciting feedback from congressional staff to inform an updated version of the toolkit to help ensure congressional offices have the information needed to support a complete and accurate count of the nation.

3. Counting children—In my state of Ohio, 106,000 children live in an area the U.S. Census Bureau considers “hard to count.” Only nine other states have more young children at risk of being uncounted. How steps with the Census Bureau take to count young children?

Answer: The Census Bureau is ensuring the messaging in our outreach to respondents and communities underscores the importance of an accurate count of young children. Some of the changes included updating the wording of various census materials to reinforce the message that the census counts everyone in the household, regardless of age or relationship to the householder. The Census Bureau also updated census taker and telephone assistance operator training materials to emphasize the importance of including young children.

The implementation team engaged with external groups, including the National Advisory Committee, the Partnership for America’s Children, and the Census Information Centers to discuss outreach strategies and ideas for achieving a complete and accurate count for the 2020 Census. The message that the census counts everyone, including young children, has been included on paid advertising, promotional materials, social media entries, and the Census Bureau website. Additionally, the Census Bureau is working on specific initiatives through the partnerships and Statistics in Schools efforts to target this problem. The Census Bureau also has a task force in the agency developing specific materials for counting young children.

4. Cybersecurity concerns—The Census is a vital democratic pillar, which allows Congress and the U.S. government to shape policies that fully reflect the population. According to the GAO report, the Census has not fully tested key IT platforms, and experiences delays in corrective actions associate with “high risk” and “very high-risk” vulnerabilities. I am troubled that foreign adversaries will use malicious disinformation tactics to undermine the population’s faith in the Census, as well as to suppress turnout.

- a. Similarly, I am troubled that malign actors would hack into Census databanks to steal the population’s sensitive data. What is the Census’ plans to strengthen Cyber protections?**

Answer:

Cybersecurity is a top priority for the Census Bureau. The Census Bureau has instituted a number of cybersecurity measures that will both protect and monitor the technology and data for the 2020 Census. The Department of Homeland Security, the Federal Intelligence Community, and industry partners have committed to provide the Census Bureau with specific support for the 2020 Census operations. This support will enhance the Bureau’s ability to be proactive and contain or stop a threat. Throughout 2019, the Census Bureau will work closely with these Federal and industry partners to develop and deploy the specific support capabilities needed for 2020 Census operations.

The Census Bureau has a comprehensive approach to cybersecurity. First, we have developed processes and procedures to ensure the systems are securely designed, built, and managed. The Census Bureau incorporates defensive layering and advanced tools into systems to identify, detect, and protect against threats. The team of cyber experts uses leading tools and methods to continuously monitor and analyze activity on the systems for threats. The team is trained to respond and recover from any identified threat, determine the source of the threat, and to take immediate action to minimize potential impact to data or systems. To complement the cyber team, the communications team is standing up a team to ensure the Census Bureau clearly communicates with partners and the public on the impact of any threat.

- b. What are the current vulnerabilities in the system, and how do you plan on mitigating them?**

Answer: To ensure the highest level of security, the Census Bureau does not disclose our security posture to the public. The Census Bureau continuously monitors its security posture to stay ahead of cyber threats. Each month the security team scans systems for more than 100,000 potential vulnerabilities, with new items added each month. The Census Bureau prioritizes remediation of any high-risk findings within strict timelines to most effectively reduce threats and improve the security of the systems. Unlike most Federal organizations, the Census Bureau intentionally tracks more findings at a detailed level to better show progress and increase visibility for our own operational purposes and our oversight bodies. Also, the Bureau has contingency

and mitigation plans in place for its systems, which complies to the Census Risk Management Framework and security policies.

- c. Does the Census Bureau FY 20 budget provide sufficient funds to allow for a robust cybersecurity protections?**

Answer: Yes, the Census Bureau believes that the FY20 budget provides sufficient funds to deliver the cybersecurity protections to ensure a safe and secure 2020 Census.

- 5. In my own district, civil society organizations tell me that they are difficulty convincing people with Spanish-speaking abilities and of Hispanic heritage to apply for Census jobs. If people don't trust the Census to apply for jobs, how can we expect them to take the Census?**

Answer: Under Title 13, individual responses cannot be shared for any reason. There are no exceptions. The Census Bureau will not share respondent information with immigration or law enforcement agencies. Responses are confidential and will not affect respondent work authorization nor will they affect the ability to reside in the United States.

The Census Bureau and its contractors have conducted extensive research in how to convey these bedrock messages to the Hispanic community in impactful ways. Research shows that many in the Hispanic community do not want an enumerator to visit their home so messages that stress the ease and confidentiality of self-response are particularly effective. Messages that reinforce that individual Census data are strictly confidential and not released and that the census is non-partisan have tested well. To ensure the Census Bureau hires a diverse workforce, recruiting materials both in print and online are available in Spanish and feature Census Bureau employees of Hispanic origin promoting 2020 Census jobs. The Census Bureau has made it easy for organizations to share recruiting information in Spanish on social media.

The Honorable Robert B. Aderholt
Subcommittee on Commerce, Justice, Science, and Related Agencies
Questions for the Record

Address Canvassing Efforts

- 1. How are or were your address canvassing efforts aligned with the specific populations identified in the Response Outreach Area Mapper (ROAM) – i.e. remote, rural, low internet use areas?**

Answer: The Response Outreach Area Mapper (ROAM) tool helps quickly show areas that traditionally have a low response rate to censuses and surveys along with characteristics of those areas, rather than help us conduct address canvassing. The partnership coordinators and specialists are targeting areas that are deemed “hard to count” to enlist community organizations to help with outreach to those areas. With regard to Address Canvassing efforts, the Census Bureau will conduct a 100-percent review and update of the nation’s address list. We rely on the U.S. Postal Service’s Delivery Sequence File as the primary source for updating and maintaining the Master Address File (MAF). Additionally, this decade we have employed a suite of ongoing processes to acquire new addresses, and maintain and update information about addresses that were already in the MAF. We were able to verify about 66 percent of the nation’s housing units using our imagery-based, in-office portion of address canvassing, completed at the end of March 2019; the results informed where we would need to canvass in the field. The in-field portion began on August 18, 2019, when we sent census workers to areas that the in-office operations could not verify; we will need to verify around 34 percent of the addresses in the country. The in-field portion will include going to some of the areas identified by the ROAM tool, including some remote and rural areas.

In addition, we have acquired address information from tribal, state, and local governments through our Geographic Support System Program. Our Un-geocoded Resolution Project began in 2017 and has geocoded over a million addresses to census blocks. We conduct the Boundary and Annexation Survey annually, to collect information about selected legally defined geographic areas to ensure that all addresses are geocoded to the correct legal jurisdiction. The Local Update of Census Addresses (LUCA) Program process provides an opportunity for tribal, state, and local governments to review the Census Bureau’s address list for their respective jurisdictions. Our New Construction Program is available to local governments to provide addresses for housing units built after LUCA and ready for occupancy by Census Day. Each of these programs and processes serves to validate addresses in the MAF, correct address locations and provide addresses that may not be included in any other address datasets. Consequently, the MAF is more complete and accurate than it has ever been.

2. What did your 2017 Address Canvassing operation reveal about your systems and operations needs?

Answer: The 2017 Census Test allowed the Census Bureau to research new methods and advanced technologies to improve data collection during the 2020 Census and was not used to test the Address Canvassing operation. We did, however, test Address Canvassing operations in portions of Washington, West Virginia, and Rhode Island during our 2018 End-to-End Census Test.

In this last test, the Census Bureau learned important lessons for the Address Canvassing operation with regard to addressing connectivity issues, particularly with respect to the business rules that define the work our field staff are doing when they are not connected to the Internet, and we are making operational adjustments to address them. Specifically, there were some instances where address listers in the West Virginia site encountered problems accessing cellular connectivity; this was expected and one of the reasons that we selected the West Virginia test site (we wanted to see what happened in areas with low connectivity). During the test, we used one national carrier to provide cellular connectivity; during the 2020 Census, the Device-as-a-Service contract will provide access to multiple national carriers and regional carriers, as well as possible roaming arrangements to ensure strong cellular connectivity during our listing operations. It is important to note that it is not a requirement for a lister to have cellular connectivity to conduct listing, which means a lister can work seamlessly in a disconnected state. The lister only needs connectivity to receive their work assignments, transmit the completed listing, and transmit payroll/administrative data.

3. How has the Census Bureau utilized the data from the ROAM with respect to its communication and partnership campaign? How has the data from the ROAM informed your estimates of field resource needs?

Answer: The Response Outreach Area Mapper is an invaluable tool for the various 2020 Census partnership programs, the partnership coordinators and specialists, and the 2020 Census communications contractor VMLY&R (Team Y&R). Team Y&R is making use of the ROAM tool in working with its subcontractors that specialize in communications with various segments of the population that are considered “hard to count.” This process involves using the ROAM, response rates, and other data to shift advertising spending levels, message content, media venues, partnership efforts, and other components of the communications campaign to focus on geographies or audience segments with lower-than-expected response rates, and adjusting resources expended on areas with high response rates, thereby gaining efficiencies.

The ROAM is one of many tools and resources that partnership specialists will leverage to help identify people living in areas that traditionally have lower response rates, such as rural areas. Partnership Program staff use Census Bureau data and research to identify the demographic characteristics of hard-to-count groups. The Census Bureau will distribute this information to partners and the general public to use when shaping their outreach efforts. In addition, regional census centers will use this information when developing

and implementing partnership activities to illustrate types of partner organizations and where, geographically, to conduct events within each region. The Census Bureau has already partnered with close to 250 national organizations across many sectors and audiences served. For example, there are currently 26 organizations serving rural audiences. Partnership specialists work closely with partner organizations; state data centers; census information centers; governmental planning offices; and tribal, federal and state organizations in addition to community leaders and organizations to inform where populations who are traditionally undercounted are and to ascertain the best outreach strategies

Preserving and Recouping the Substantial 2020 Census IT Investment

- 4. The United States' predominant investment in the 2020 Census is the massive integration effort associated with the modern, Internet-based enumeration. With the 2020 Census IT systems migrated to the Cloud, integrated, tested, scaled and secure for the 2020 Census, what are the Census Bureau's plans to preserve this investment to reduce the cost for the 2030 Census?**

Answer: As the Census Bureau transitions from 2020 Census operations, the agency will look to leverage the 2020 IT investments for use to support enterprise survey operations. While the 2020 Census is unique from a scale and operational perspective, certain capabilities are applicable to all survey operations. For IT investments that support capabilities that are common across other survey operations, these investments will be assessed for application for the remainder of the enterprise. Decisions related to system expansion, modification, or decommissioning will be informed by future data collection, processing, and dissemination approaches that are influenced by external environmental factors, strategic planning, cost/benefit analysis, and risks associated with these alternatives. For example, looking to the future and more reliance on administrative and third party sources of data to improve and optimize collecting data and producing statistics will guide architectural decisions and accompanying systems for ongoing survey operations and planning for the 2030 Census. The Census Bureau already has begun these assessments, which will continue through FY 2020 to ensure that by FY 2021 the organization is well-positioned to begin transitioning relevant capabilities to survey operations and planning for the 2030 Census.

Cybersecurity (For the Census Bureau)

- 5. What are the greatest cyber security risks involved with the 2020 Census?**

Answer: Risks external to our systems such as social engineering, respondent device flaws, and invalid respondent data are the greatest cyber security risks to the 2020 Census. The Census Bureau, like other organizations, cannot prevent against unknown external threat to respondent devices or vulnerabilities in respondent networks. The Bureau is partnering with industry and government organizations to promote knowledge, understanding, and awareness of these types of threats for secure response submission.

6. **Will you describe your efforts to learn from the experience of social media companies about combatting the kinds of threats that could undermine participation and the accuracy of the count?**

Answer: The Census Bureau has an extensive social media monitoring and listening strategy in place. By partnering with industry-leading technology companies and using their lessons learned from worldwide elections, the Census Bureau is training staff and contractors to identify different types of potentially malicious social media that spread misinformation. Additionally, the Census Bureau is sharing social media threat intelligence with Federal partners.

7. **How will the Census Bureau maintain confidentiality with respect to the personal information of respondents?**

Answer: Systems and processes, employed for Census operations comply with requirements for collecting and storing confidential data, as mandated by Census Bureau and Department of Commerce policy and procedure. Anyone working on Census operations must abide by the Title 13 and Title 26 confidentiality requirements. Because every response is confidential, access is controlled to such information through strict procedures and policies. Violation of the confidentiality requirements of Titles 13 and 26 are punishable by fines and imprisonment. Census Bureau staff are trained annually and pass a test to ensure they are up to date with the policies and access the data on a business need basis. Additionally, the systems protect the data through means, such as encryption at rest and access controls, and are assessed independently by the Census Bureau's Office of Information Security and the Census Bureau's Privacy Office before being approved for deployment.

Integrated Communications Contract

Under the Integrated Communications Contract, the prime contractor, Young and Rubicam, has partnered with six other firms and subcontracted with 10 additional vendors with expertise in reaching select audiences.

8. **Which, if any, of these subcontractors has expertise in communicating with rural communities?**

Answer: The 2020 Census Integrated Communications Campaign contractor Team Y&R has extensive expertise reaching rural communities. Team Y&R is supported by subcontractor DCG communications, which focuses on veteran communities everywhere, including rural areas. All subcontractors have been instructed to ensure that their creative content, where appropriate, takes rural communities into account.

9. What is being done to ensure this and other Census efforts are free of political influence?

Answer: The energetic leadership of Secretary Ross and other Department of Commerce and Census Bureau political leadership has helped ensure the Bureau is adequately funded to fulfill its constitutional mandate. Close collaboration with and the support provided by Commerce political leadership for conducting a complete and accurate census have enabled the Census Bureau, an agency comprised almost entirely of career federal statisticians, survey methodologists, and economists, to do their jobs better. Political and career staff members collaborate effectively on all aspects of the 2020 Census, including working alongside our in-house and Team Y&R communications specialists on our advertising campaign. Together, they have been developing the research foundation that will inform the development of the media plan and the messaging. To bolster the reach of our advertising campaign, we are enlisting partners, spanning the political spectrum and representing diverse groups across the nation in both rural and urban areas, to help get out the message that the 2020 Census is easy, safe, and important. The Census Bureau, under the leadership and with the full support of the Commerce Department, will conduct a complete and accurate decennial census.

US Census Bureau

Follow-up Questions from House Appropriations Committee to April 30, 2019 Hearing QFRs

Original Question from QFRs Sent to Committee:

4. **How does Commerce intend to use the data provided by the Department of Homeland Security (DHS) for its Decennial operation?**

Answer: Title 13 of the United States Code instructs the Census Bureau to obtain administrative records to the maximum extent possible and when consistent with the statistics required. The use of the administrative records will result in producing citizen and non-citizen estimates for the voting age population at the block level. The Census Bureau is seeking data from DHS to supplement its existing administrative records and provide additional information on citizenship. The format of the data product is in development and is planned to be released by March 31, 2021.

In accordance with Title 13, all information obtained about individuals through administrative records will be used only to produce statistics and will be subject to the confidentiality provisions of Title 13. As a result, the Census Bureau is restricted from providing information to any entity that identifies an individual or otherwise violates Title 13 confidentiality provisions. Protecting confidentiality is not only a legal requirement, but also part of the culture of the Census Bureau. All employees take a strict lifetime oath of confidentiality. Anyone who violates that oath is subject to five years in prison and up to \$250,000 in fines, or both.

Follow-up Received Oct 7: When you say the “format of the data product...[will] be released by March 31, 2021” what do you mean exactly? Also, the block level is the smallest geographic category – won’t this require 100% data (administrative records) input? This seems like a huge undertaking. What are the next steps here?

Answer: To clarify, date in the answer should read “March 31, 2020.” Producing block level citizenship data is a complex endeavor, and the Census Bureau is committed to developing product specifications in a transparent process.

Regarding your question about estimates at the block level and whether they require 100% data, while the Census Bureau attempts to follow up with non-responding households, no data product ever achieves 100 percent response, including the decennial census. Even when accounting for coverage of administrative records, the data will not achieve 100 percent coverage. We intend to use vetted statistical methods, including a process we call imputation, to account for the households for whom we have no data. We believe that in terms of accuracy, this data product

will outperform our prior block-group-level data products based on the American Community Survey.

Original Question from QFRs Sent to Committee:

10. **Is Census looking to expand its hiring to legal permanent residents? And does the U.S. Census currently hire LPRs who qualify for employment as specified under current law?**

Answer: Yes, the Census Bureau anticipates there may be a need to hire non-citizens to serve as translators in limited circumstances. The Census Bureau has established a “translator” position for the 2020 Census to acquire the specific languages skills needed to facilitate enumeration and the Census Bureau. Consistent with existing employment and appropriations law, and as the translator position is a temporary, excepted service position, which exists solely for the purposes of conducting the 2020 Census, the Census Bureau may hire non-U.S. citizens for these positions. As a point of reference, during the 2010 Census, the Census Bureau hired approximately 3,500 non-citizens out of a total workforce of more than 700,000 temporary employees to assist with enumeration activities, representing less than 0.5% of the total temporary census workforce. The Census Bureau anticipates a similar percentage of non-citizens could be hired as translators during the 2020 Census.

Follow-up Received Oct. 7: it sounds like the Bureau is able to (in limited circumstances and consistent with applicable laws) hire LPRs – but the Census website in its FAQ section does not express this caveat under the question “Can noncitizens be hired to work on the 2020 Census?” Are we missing an opportunity to attract folks who may be eligible for these translator positions? Is Census considering an update to its website?

Answer: We will update the FAQ to reflect the translator eligibility.

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