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MICROELECTRONICS: LEVERS FOR PROMOTING SECURITY AND INNOVATION

Tuesday, July 20, 2021

U.S. House of Representatives,

Permanent Select Committee on Intelligence,

Subcommittee on Strategic Technologies

and Advanced Research,

Washington, D.C.

The subcommittee met, pursuant to call, at 10:10 a.m., in Room 2359, Rayburn House Office Building, the Hon. Jackie Speier [chairwoman of the subcommittee] presiding.

Present: Representatives Speier, Himes, Maloney, Krishnamoorthi, Crawford, and Mullin.

Chairwoman Speier. Good morning, everyone. The subcommittee will come to order.

Before we begin, I want to remind all of our members that we are in open session, and as such we will discuss unclassified matters only.

Without objection, the chair may declare a recess at any time.

I welcome our members and witnesses to today's hearing. Good morning and thank you to our witnesses for being here today. We are in for some pretty remarkable testimony from some very impressive individuals.

This hearing is on an important topic that will examine how U.S. investments in microelectronics can both spur American innovation and provide the Department of Defense and the Intelligence Community with secure, reliable chips that are essential to their mission.

The microelectronics market has evolved considerably in the past 50 years. Where once U.S. companies were the global leaders in design, fabrication, and packaging of microelectronics, we now face a world where a single chip can travel to more than 70 countries during the production process. Where once the U.S. Government drove market innovation and production schedules, we now see private companies commanding nearly all the demand for chip production.

These changes bring both opportunities and challenges. The innovation and advances in microchip technologies over the past several decades have unlocked enormous economic activity and prosperity. They have brought to us the iPhone, cars with safety cameras, and countless other devices that we now take for granted.

For the DOD and the IC, however, the globalization of the microelectronics market has created both reliability and security concerns.

And as the pandemic has shown us, our supply chains are more fragile than we ever imagined, and we see that now in the chip shortage for auto manufacturers in particular. Single points of failure along vital supply chains create cascading effects and chaos to our everyday lives.

This subcommittee is not the first to look at ways in which the U.S. can gain access to secure, reliable, and state of the art microelectronics. For years, DOD and the IC have relied on what we call, quote, "trusted foundries," unquote, to produce the chips that go into our most advanced weapon systems. This model, however, has created a situation where these trusted foundries are not taking advantage of the cutting-edge production capabilities that are used elsewhere.

In balancing these challenges there is an opportunity for microelectronics production to be an industry of the future for American workers. Advanced manufacturing, chip design, and chip packaging are areas where we need to make sure the U.S. remains the global leader in innovation. These are the jobs of the future and a key to ensuring American prosperity for generations to come.

Today we will hear from the witnesses about what options and tools are at our disposal that address the legitimate security and reliability concerns within the microelectronics market, while spurring American innovation.

As a subcommittee, we intend to look at existing programs, such as the Small Business Innovation Research Program, known as SBIR, which provides small businesses an opportunity to contract with the Federal Government and create a pipeline for new high-tech products.

We also intend to look at new areas where the U.S. can reduce the friction and cost for private companies to innovate and bring new technologies to market, such as a potential fund that bridges the gap between research and development and

commercialization.

Essential to the development of all technologies of the future is a technical and talented workforce. Our skilled and diverse workforce has been the key to American success for generations, and we must continue to invest in our people if we hope to compete in the decades to come.

One of the alarming points that was made in one of the documents that we received last night was that in the United States the number of graduate students in these fields of engineering and computer science was at 90,000 -- or 80,000, I think it was -- back in 1990.

It is still at that number today, while the number of international students coming to the United States in these graduate programs has jumped from some 50,000 to 140,000. So we have a lot of work to do internally in this country as well.

The U.S. Government must also create an environment where we can recruit, hire, promote, and retain a technical, talented, and diverse workforce. Only by having access to the top talent in chip design and chip manufacturing can we ensure that the advanced chips we buy perform as intended.

I thank the witnesses for their time in appearing today.

I now yield to my ranking member, Mr. Crawford, for any opening remarks that he has.

[The statement of Chairwoman Speier follows:]

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Mr. Crawford. Thank you, Madam Chair.

As you know, I am filling in for my colleague, Mr. Stewart, who is unable to attend today. And so I will submit his comments for the record. And I yield back.

[The information follows:]

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Chairwoman Speier. All right. We now will hear from our witnesses.

And we will start with you, Dr. Porter. You are welcome to make your opening remarks.

I would like to point everyone to her bio because it is pretty darn impressive.

Thank you.

STATEMENTS OF THE HONORABLE LISA PORTER, FORMER DEPUTY UNDER SECRETARY OF DEFENSE, RESEARCH AND ENGINEERING; MR. WILL HUNT, RESEARCH ANALYST, CENTER FOR SECURITY AND EMERGING TECHNOLOGY; AND MR. DAVID ISAACS, VP, GOVERNMENT AFFAIRS, SEMICONDUCTOR INDUSTRY ASSOCIATION

STATEMENT OF LISA PORTER

Ms. Porter. Thank you very much.

Chairman Speier, Ranking Member Crawford, and members of the subcommittee, thank you for being here. Thank you for the opportunity to participate in this important hearing regarding levers for promoting security and innovation in the microelectronics industry.

While people often equate the microelectronics industry with foundries and fabless design houses, the value chain of the industry is highly complex and global in scope, with a vast network of thousands of suppliers performing specialized tasks at many different levels of the lifecycle, for example, specialty gases and chemicals, silicon wafers, Electronic Design Automation software, lithography tools, packaging, and test.

The international division of tasks and the interdependencies among the thousands of participants has enabled the growth of the global industry to more than $470 billion. That is a 2018 number; numbers projected for 2121 are about $450 billion.

In recent years, the global nature of the industry has raised concerns regarding the security of the chips being produced and of the supply chain that produces them. There are those who would argue for the creation of "trusted" onshore foundries and for limiting all actors in the supply chain to only those who can be trusted. Such a

perspective is not only naive, but also dangerous.

Fortunately, this industry can learn from similar mistakes made by the cybersecurity industry in years past, mistakes that they are now rectifying through widespread adoption of the Zero-Trust approaches.

The pursuit of "trusted foundries" and "trusted supply chains," like "trusted networks," is the opposite of a Zero-Trust approach. It actually makes us more vulnerable to the things we are trying to protect ourselves from. "Zero-Trust" and "trust" cannot coexist as goals.

Executing the entire semiconductor manufacturing lifecycle inside the United States is simply infeasible. But even if we could somehow recreate the entire value chain within our borders, walling ourselves off from the rest of the global enterprise, security is not guaranteed. Perimeter defense methods that assume you can build a secure perimeter around your network or foundry or supply chain and guarantee that everything inside can be trusted have repeatedly failed us.

Edward Snowden was a stark reminder of this almost 10 years ago. Recent cyber attacks launched through access to U.S. companies' software -- for example, SolarWinds -- has served to reinforce this lesson.

The Zero-Trust philosophy assumes that everything in a complex system -- be it supply chains, networks, software -- either has been or will be compromised, regardless of location. It advocates for the use of data-driven, quantitative risk assessment and management techniques. And importantly, its focus is on resilience, ensuring that when a risk materializes its impact is minimized.

It is important to note that not all risks are malicious in nature. Often unintentional human mistakes or significant weather events or natural disasters can produce negative consequences if resilience has not been emphasized.

If we look at this complex global industry through the lens of Zero-Trust, then what is needed?

First and foremost, the establishment of quantitative, measurable security standards along the entire lifecycle should be a major focus of our efforts. The DOD has recently begun such work, in collaboration with the commercial sector, through its emphasis on quantifiable assurance in programs that leverage the fact that the data that commercial fabs already collect for quality control can also be used for security standards. But this work needs to be broadly supported and accelerated.

In the recent past, the DOD tried to obtain what it needed by using "trusted foundries," which left it vulnerable to the flawed perimeter defense approach, as well as unable to access state of the art capabilities available to the rest of the world.

During the past few years, the DOD has pivoted to a Zero-Trust approach to accessing microelectronics that aligns its incentives with those who will be driving the demand signal for this industry over the next decade, to include the telecom, medical, automotive, and IoT industries, and who will also want the means to quantitatively assess risk in their supply chains and their chips.

Success here will require the development of data collection and analysis methods applied along the entire lifecycle in a manner that does not introduce significant throughput impact or prohibitive cost penalties.

Collaboration among government and commercial sector stakeholders to, one, establish standards, two, develop tools and methods for assessing compliance with those standards, and, three, develop methodologies for assessing residual risk once standards are employed is an activity whose benefits would accrue to all.

Second, while geography does not guarantee security, the fact that a single location -- TSMC in Taiwan -- currently accounts for the majority of the global foundry

market does not reflect a resilient supply chain.

This lack of resilience should be of concern to the dominant customers of the market, and the U.S. Government should work closely with those customers to better understand the impediments to diversifying their source of advanced chips.

If a clone of TSMC were constructed in the U.S. or another allied nation, would that be sufficient for those customers to port over a significant portion of their work to that foundry? If not, what more is required? And is there an appropriate role for the U.S. Government to help enable that?

One likely impediment is workforce. Foundries have no value without a skilled workforce. The U.S. should carefully consider incentives to attract the best and brightest from within its borders, as well as from around the globe, to pursue careers in this industry.

And it is important to note that this is not just about advanced engineering degrees. Highly trained technicians are extremely important to the success of this industry.

Finally, concerns about U.S. leadership in this industry are often raised separately from the security concerns addressed above. The U.S. is currently a leader in several critical areas of the industry, to include the design of chips, EDA software, RF chip design and manufacturing, and specialty tooling. Furthermore, DARPA is still recognized as a global leader of cutting-edge innovation in this domain.

Before taxpayer dollars are spent to enhance the U.S. leadership posture, it is imperative that the goals are clearly defined: What does success look like and how will it be measured?

It is worth noting that those who define the standards of an industry are the ones who have the most influence over it. And for a country with less than 5 percent of the

world's total population, influence over what gets built and to what standards is a significant means of exerting influence and hence leadership.

Thus the pursuit of quantitative, measurable security standards, and the tools and methods needed to enforce them, may go a long way towards addressing both security and leadership concerns facing the U.S. with regard to this industry.

In closing, it is worth emphasizing that the nature of this global, complex, intertwined industry is such that government intervention can distort the market in ways that are hard to predict, leading to unintended and undesirable consequences.

Any attempts by the U.S. Government to influence this complex market should focus on the incentives of the demand signals driving the market -- for example, through standards -- and extreme caution should be exercised before any subsidies are provided to the supply side.

The government, by its very nature, is ill-suited to pick winners and losers in the market. Any subsidy targeting a specific part of such a complex value chain -- or even worse, specific companies within the chain -- will weaken the competitive forces of a free market that correct for poor performance and poor alignment with the market demand.

Furthermore, intervention through the use of export controls to try to prevent technology transfer often backfires in two important ways. It incentivizes others to build indigenous capability and it shelters our companies from international competition, while limiting their access to global markets.

The aerospace industry provides a cautionary tale to any who would propose using export controls to enhance our global leadership posture in this or in any other technology industry.

While export controls usually do provide a short-term advantage, and timelines for others to develop indigenous capability may be long, there is no finish line.

Whatever choices we make, it is important that we take the long view as our adversaries have been doing.

And we must not let our fears lead us into the trap of emulating the tactics of nations whose principles are contradictory to our own. We must play to our strengths, which include our culture of innovation, our free market principles, our entrepreneurial spirit, our respect for intellectual property and the rule of law.

It is these strengths, taken together, that will enable us to maintain a leadership position in this important global market.

Thank you. And I will be happy to take questions.

[The statement of Ms. Porter follows:]

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Chairwoman Speier. Thank you, Dr. Porter.

Now we will hear from Mr. Will Hunt from the Center for Security and Emerging Technology.

STATEMENT OF WILL HUNT

Mr. Hunt. Chairwoman Speier, Ranking Member Crawford, members of the subcommittee, good morning, and thank you for the opportunity to speak today. I have submitted my full testimony to the subcommittee so I will just summarize the main points here.

First, I will argue that while funding the CHIPS for America Act is an important first step, the United States must take further steps to promote its incumbency advantages across the semiconductor supply chain. Above all, this means further R&D investments, workforce development, and high-skilled immigration.

Second, I will outline how to protect the fruits of these promotion efforts through research, security, and export control policies supported by robust open source intelligence.

The United States enjoys an incumbency advantage in the semiconductor supply chain. During the 1940s, Bell Labs researchers made Nobel Prize-winning advances, which laid the groundwork for the first modern semiconductors.

Over the follow decades semiconductor manufacturing has developed into a more than $400 billion industry and a global supply chain, powering everything from smartphones to advanced weapon systems.

Fortunately, the United States and its allies collectively dominate the highest value

parts of that supply chain. That includes advanced materials, manufacturing equipment, chip design and related software, and core intellectual property, all of which are required for leading-edge manufacturing, which we also dominate.

By contrast, China, despite its heavy investments in semiconductor independence, relies on the United States and its allies for many key manufacturing inputs, as well as for leading-edge manufacturing.

What can the United States do to promote these advantages?

An important first step is funding the CHIPS for America Act, a bipartisan bill cosponsored by Representative Stefanik, which was signed into law during the 116th Congress. This will help ensure against a near-term potential disruption in the supply of chips from South Korea or Taiwan.

Currently, such a disruption would have global consequences, because virtually all industries in the economy rely in some way on chips made in these two countries.

But as noted in a letter to President Biden signed by both Democrats and Republicans earlier this year, even full funding of the originally filed CHIPS provisions pales in comparison to the investments China is making in its own semiconductor industry.

The CHIPS for America Act provides some R&D funding to address near-term issues, like advanced packaging, but longer-term investments in R&D are needed. For example, IARPA has been working on novel energy-efficient approaches to computing which could greatly reduce the costs of encryption and other computing tasks.

The United States should make further such investments across a portfolio of hardware paradigms.

In a different vein, advanced chips specialized for high-speed machine learning lack some of the security features of general purpose computing chips. To address this

vulnerability, the United States should invest in developing security guarantees for AI chips.

Of course these promotion efforts, especially CHIPS Act funding, will likely generate a spike in demand for semiconductor talent.

Unfortunately, the United States lacks the American-born talent to fully address this new demand. Forty percent of the U.S. semiconductor workforce is foreign born, and the number of American graduate students in semiconductor-related fields has flatlined since 1990, while the number of foreign-born students has more than doubled.

Thus, in the short term, addressing this new demand will require high-skilled immigration, perhaps through special visas for experienced semiconductor workers.

In the longer term, however, the United States must invest in its supply of domestic talent, for example, through fellowships in semiconductor-related disciplines.

Finally, the United States' large pool of foreign-born talent also raises the possibility of espionage. The Chinese Government in particular has a vast infrastructure devoted to transferring S&T knowledge from the United States and other countries to China.

To counter China's efforts, the United States must invest more resources in open source intelligence to support visa screening. Better open source intelligence is also needed to ensure that U.S. export control policies remain effective and up to date. Mapping and monitoring of the supply chain, as well as vectors of technology transfer, should therefore be prioritized in the National Intelligence Priorities Framework.

In conclusion, funding the CHIPS for America Act is an important first step towards sustaining U.S. and allied advantages in microelectronics. But further steps are needed to promote U.S. semiconductor talent and innovation, while protecting the fruits of that innovation with research security measures, expert controls, and open source

intelligence.

I thank the subcommittee for the chance to speak today, and I look forward to your questions.

[The statement of Mr. Hunt follows:]

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Chairwoman Speier. Thank you, Mr. Hunt.

Now we will hear from David Isaacs, who is the Semiconductor Industry Association government relations vice president.

STATEMENT OF DAVID ISAACS

Mr. Isaacs. Thank you, Chairman Speier, Ranking Member Crawford, and members of the committee. I appreciate the opportunity to be here today. And I think this hearing is very timely and a strong recognition of the importance of secure semiconductors to our national security, our economy, and our technology leadership.

I think, Ms. Speier, you highlighted the concerns with the shortage of automotive chips. And this is happening in cloud computing and medical devices and industrial equipment in a range of industries across the spectrum, and it is a very strong concern for our economy.

The Pentagon recognizes the vulnerabilities with the chip supply and the overreliance on foreign sources in a vulnerable supply chain.

Also, semiconductors are the fundamental enabling technology of the "must win" technologies of the future, such as AI, quantum computing, and 5G and beyond telecommunications.

So I think it is being widely recognized that it is a national priority that the U.S. needs to lead in this area. And so we appreciate this committee's actions in this area.

As has been touched on by the other panelists, I think we are facing a number of challenges to our U.S. leadership. We have a very strong position as America in the semiconductor industry and technology. We lead in the core IP, we lead in the

manufacturing equipment, we lead in chip design. But we have fundamental vulnerabilities in manufacturing and materials and other parts of the supply chain.

And part of that is due to the fact that our global competitors are heavily investing in this area. They are seeking to displace U.S. leadership. And they are providing massive subsidies, massive support to their industry. And as a result, over time America used to account for 37 percent of chip capacity in 1990 and now that is down to 12 percent.

And we did a study that estimated that the cost differential of building and operating a fab in the United States is 20 to 50 percent more expensive than overseas, which is largely due to the support given by other governments. And it is important to note that the U.S. lacks comparable subsidies at this time.

At the same time, other countries are doubling down on research and seeking to overtake our leadership in technology, and U.S. investments in research have been relatively flat over time.

I think Dr. Porter outlined some of the key supply chain vulnerabilities, whether it is geographic concentration and the risks posed by geopolitical disturbances, trade vulnerabilities, natural disasters, and the like.

And so we think that the Pentagon, critical infrastructure, the Intelligence Community are vulnerable to that kind of concentration. And that can be addressed, at least in part, by having more onshore capability.

And then finally, as both Dr. Porter and Mr. Hunt outlined, the workforce issues are real. We rely on access to the best and brightest from around the world. And, unfortunately, our domestic STEM education system is not producing the number of graduates we need to maintain our leadership.

And as the chair acknowledged, two-thirds of graduate students at U.S. colleges

and universities in science, computer science, physics, chemistry, other core programs are foreign nationals, over two-thirds of the graduate students. And so we need access to that talent and to keep them here.

So what are the solutions?

First and foremost, as has been mentioned, there is bipartisan legislation called the CHIPS Act, that we provide incentives for semiconductor manufacturing and investments in research. That legislation passed the U.S. Senate as part of the U.S. Innovation and Competition Act, the broad China competitiveness package. It provided $52 billion in emergency supplemental funding for manufacturing incentives and research investments.

And just to correct the record from Will, Ms. Stefanik was an important cosponsor of the bill. The key lead sponsors were Ms. Matsui and Mr. McCaul. A bipartisan bill here in the House.

But it passed overwhelmingly in the Senate, 68 to 32. And we believe it is imperative that this bill be included for action in the House. It is important to reverse the decline in U.S. manufacturing and increase our research investments.

At the same time, we need to keep a strong investment in basic research at our core research agencies, DARPA, DOE Office of Science, the National Science Foundation, and NIST, working with the National Labs and the universities. Those entities, that is the crown jewel of our scientific enterprise in this country, and we need to maintain our technology leadership.

We are not going to outspend China. We are not going to outspend these other countries. But we can outrun them. And that is by doing what we do best, which is innovation and leadership.

And these research investments will also build the workforce that we need to

compete and maintain our leadership.

I should also add, in terms of manufacturing incentives, there is also bipartisan legislation in the Senate called the FABS Act. That would provide a 25 percent investment tax credit for constructing and equipping new fabs and modernizing existing fabs. And we think that should be part of a holistic strategy to revitalize semiconductor manufacturing in the U.S.

And so we think the time is now. We have, again, the Senate-passed legislation, and we are eagerly waiting for the House to act. And we look forward to working with this committee and the House as a whole.

Thank you.

[The statement of Mr. Isaacs follows:]

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Chairwoman Speier. Thank you, Mr. Isaacs.

Thank you all for your presentations.

For those who are watching us and trying to understand the microelectronics area, a $150 million dollar chip-making tool would take 40 shipping containers, 20 trucks, and 3 Boeing 747s to bring the equipment to a particular place for installation. So it speaks to the complexity of it.

Let me ask each of you about what would you assess the greatest security vulnerabilities are to the Intelligence Community, that the Intelligence Community should be concerned about as we look at the different parts of chip fabrication.

Let's start with you, Mr. Hunt.

Mr. Hunt. Thank you.

I think it is a really important question. I think the security vulnerabilities that we have all outlined here are critical and we do need to address them.

It is not something I have looked into very deeply myself, but I do agree with Dr. Porter that the trusted foundries approach is not sufficient to tackle the issue and we do need a Zero-Trust approach. So I think that is a high priority.

Chairwoman Speier. Dr. Porter.

Ms. Porter. Yes. And to add on to that, I think, as the Intelligence Community -- and of course in an unclassified session we will just leave this at a very high level -- but as they think about the threats and they understand them, I think, pretty well, they do have to embrace what Zero-Trust really means.

And it means, if you think you are going to build something onshore and therefore make it safe just because it is onshore with a nice barrier to entry, you are already creating a vulnerability.

And that is why I tend to really emphasize the Edward Snowden example. He really drilled that into our consciousness, or he should have. You can't create trusted perimeters and trust everyone inside. That is where you create huge vulnerabilities.

So however the IC decides it wants to ensure that it has an access to capability, it needs to do the trade-in risk properly. And it needs to understand every time it tries to drive to zero risk, what it does is create a huge opportunity cost. And what I mean by that is it walls itself off on access to the state of the art chips that are being developed.

So their strategy has to be one in which the IC says: What do I really need in terms of a risk profile perspective? And what is the opportunity cost I risk when I don't allow myself access to the best rather than just saying, "I am going to wall myself off and create my own little foundry or whatever capability"?

Chairwoman Speier. Mr. Isaacs.

Mr. Isaacs. So earlier this year the administration issued a supply chain executive order and then issued a report on the semiconductor supply chain and they highlight some of the vulnerabilities in the supply chain. And SIA also issued a report.

And I think it is very clear that for the Intelligence Community and the U.S. as a whole there are some very clear gaps and vulnerabilities in the ecosystem. And, again, that is what the CHIPS Act is designed to address.

So as Dr. Porter mentioned earlier, the U.S. is 100 percent dependent on Taiwan and Korea for the most leading-edge chips.

One part of that solution is to ensure that there is some level of onshore capability. We don't need to be 100 percent self-sufficient. We are dependent on a complex global supply chain and leveraging that supply chain has been an advantage for the United States.

We are not looking to be self-sufficient, but we need to fill in gaps and

vulnerabilities that exist for the IC and the economy as a whole.

Advanced packaging is another area. That is a step in the process where the chip is assembled, tested, and put in a package that then can be mounted on a circuit board and incorporated into a product.

There are other gaps with regard to memory, technology, and analog technology, and other things. And, again, I think a strategic look at filling in those gaps would be timely and enhance the U.S. national security and our economy.

Chairwoman Speier. Thank you.

Mr. Crawford.

No questions?

Who is next?

Mr. Krishnamoorthi?

Mr. Krishnamoorthi. Yes.

Thank you, Madam Chair.

And thank you so much for the presentations. I really enjoyed them.

I guess, first of all, I just want to direct the first question to Dr. Porter.

My understanding is that the U.S. leads in chip design and in specialty manufacturing tools. I assume the Chinese Government has invested a lot in trying to gain superiority in those particular areas. Why is it that the U.S. currently maintains leadership still?

Ms. Porter. That is an excellent question. And I would say that we just had quite a head start in this industry.

My concern is more how we look at things going forward in the future, and I highlighted this in my opening remarks. We really have to play a long game here and ensure that they don't catch up at some point.

Mr. Krishnamoorthi. Are they catching up?

Ms. Porter. There are a lot of smart people in China who are working really hard on this problem. So I don't have insights into exactly where they are. David may be able to comment more about their current status.

But I would say that I would bet on them trying really hard to catch up. And I would bet on us, because as David was mentioning earlier, we can outrun, and we need to focus on being able to still outrun.

I think he and I were both saying in different ways: Don't change how we are as a country in order to try to maintain that leadership position. We run fast because we have all of these capabilities in our country that they don't have.

Mr. Krishnamoorthi. Got it.

I just want to draw your attention to a bipartisan piece of legislation that Congressman Stewart and I authored that became law last year. It is called the H.R. 8763 SEMI Act. It basically authorizes IARPA to create a competition to award grants to advance microelectronics research.

IARPA just put out the request for proposals and accepted the submissions as of June 30. And we are really excited to see what the proposals end up generating in terms of cutting-edge research.

I saw, Dr. Porter, that you headed IARPA, if I am not mistaken.

Ms. Porter. Yes.

Mr. Krishnamoorthi. You were the first Director.

Ms. Porter. I was.

Mr. Krishnamoorthi. Can you talk about the importance of this type of a research program and also point us to successes in the past that have advanced our leadership in microelectronics through IARPA?

Ms. Porter. Sure. Thank you so much for your support of IARPA. You can imagine I am a little biased there. It has the same spirit as DARPA in terms of really trying to push the state of the art and understand where we can get high-risk, high-payoff reward research.

In the case of microelectronics, ironically, we started a program back then called circuit analysis tools. And believe it or not, that was when 65 nanometers was pretty exciting and 22 was kind of seen as the gold standard, believe it or not. So things have really evolved quite a bit.

But that technology found its way into a lot of our National Labs and is used today for very important uses, both unclassified and classified.

Mr. Krishnamoorthi. When was IARPA created?

Ms. Porter. It was created 2008, January. It was actually the end of 2007, and then I stepped in, in early 2008. And this committee and the SSCI both, I will just give a nod to all of you and your predecessors, just fantastic support. It wouldn't exist, frankly, without the support of Congress.

Mr. Krishnamoorthi. Great. Thank you.

Next question is TSMC in Taiwan. I am very concerned about Taiwan and, obviously, its ongoing tensions with China.

What I am trying to understand is this: How much does the Chinese Government and how much does Chinese industry rely on the success of TSMC?

In other words, how much do they source from TSMC in terms of their own chips that they use for whatever industrial, commercial, or military purposes that they have?

Ms. Porter. Right. And, David, I am going to turn to you also to amplify this.

But, as you know, there was some recent legislation that prevented TSMC from essentially selling to -- I think it was SMIC at least -- David, correct me if I am wrong -- and

HiSilicon, the design shop for Huawei, because the tools -- we put some controls on the tools and the use of American and ASML tools, not to get in the weeds.

The point is, I think at the moment they are being forced to develop more capability indigenously, because certain controls have been put into place.

But I would actually defer to David on this, because I think you are more current, David, on the latest in that regard.

But your macro question is the right question. We need to ask ourselves, do we want to influence globally what happens or do we want to retreat? And by retreating, what risk do we take?

And what I am advocating for is to make sure that we are not relying on one particular area, because of resilience. Taiwan is not just an issue because of geopolitics. What if a tsunami came or another natural disasters? It is just a troubling situation.

Mr. Krishnamoorthi. I guess when I am trying to get at -- and maybe, David, you can kind of address this -- is, obviously, if they went to war, TSMC would be affected. And I just want to understand how much they would be willing to hurt themselves in the process by initiating hostilities with Taiwan.

Mr. Isaacs. I am not able to quantify the level of dependence or reliance. But I guess the short answer is, yes, I think Chinese design companies and others do rely on TSMC.

The term "foundry" means a contract manufacturer that fabricates chips for other companies. And some people have referred to TSMC as the Switzerland of the chip industry, they work for all comers.

And U.S. companies are very reliant on them. They are good at what they do. And I am pleased to say they have announced a new fab in Arizona, partly spurred on by the prospect of CHIPS funding, and I think that would be an important step forward for

our country. Other companies have announced projects as well.

But they are a leading company for our industry, and the world is dependent on them in many respects. And as Dr. Porter just mentioned, the concentration in a single geography of that capability is troubling from a geopolitical perspective, natural disaster, power outage, you name it.

Mr. Krishnamoorthi. Thank you.

Chairwoman Speier. The gentleman's time has expired.

Mr. Mullin, you are recognized for 5 minutes.

Mr. Mullin. Well, I do have questions, but this isn't the right setting for it.

And, Ms. Speier, I know we have worked together on issues and so this isn't directed to you, probably more towards Chairman Schiff. But this isn't Commerce, this isn't Energy and Commerce, and these comments that we are having are more designed for it.

And as, Dr. Porter, you said a while ago, that we have to have this at a high level because we can't have the hearing that we should. We should be down in the SCIF. I mean, this is the Intelligence Committee. We should be having this down in the SCIF and asking these right questions to get where we need to go.

As I said, Ms. Speier, I am sure this isn't directed to you as much as it is to the chairman. But how can we ask the right questions in an open setting like this?

Chairwoman Speier. Well, Mr. Mullin, I think your point is well taken. But it is also important, as much as we can, to hold public hearings so that the American people can become more alert to some of the threats that exist and the microelectronics impact that it has on our daily lives.

Mr. Mullin. I sit on Energy and Commerce, as you know, and that is exactly what we could have done in Energy and Commerce, too, because the impact on the daily life is

the commerce part of it, too.

This is affecting all of us. It affects from the vehicles that my wife and I own with the companies that we have. We have been waiting for four quarters now to get orders of vehicles from GM because we have to have a special order and we can't even get them in.

And so it has affected everybody, but that is from the Commerce side of it. On the Intelligence side of it, we are dealing with another government that has caused issues and disruption. And those are the questions that we need to have. And that is why the Intelligence Committee exists and that is why the Energy and Commerce Committee exists.

And as I said, Ms. Speier, this isn't directed as much to you as it is to Chairman Schiff.

And with that, I will yield back.

Chairwoman Speier. All right. Thank you.

Any questions, Mr. Himes?

Mr. Himes. Yes.

Chairwoman Speier. You are recognized for 5 minutes.

Mr. Himes. Thank you. Thank you, Madam Chair. And thanks for the presentation.

I guess just two questions. And by the way, thank you, thank you for your work, particularly, Dr. Porter. In the last Congress I chaired the subcommittee and I got really up close and personal with IARPA and DARPA and the National Labs and In-Q-Tel and stuff. It was really gratifying to see the innovation occurring inside those Federal entities.

I guess my question is -- two questions. Number one, we sometimes forget that

we are not the only ones exposed. Everybody is exposed to the fact that supply chains are massively global and hugely complex.

So I hear the story that the Chinese are onshoring a lot of this stuff. But at what point are they substantially more protected against an event that causes a shortage of critical national security-oriented chips? I mean, you have got to get the whole supply chain. It is not good enough to have 90 percent.

I mean, I remember -- I can't remember if it was ZTE or Huawei, but I remember the Trump administration negotiating with them, because as angry as we were at them, they would go out of business if we didn't provide them chips.

So to really be protected, you need 100 percent of the supply chain.

Ms. Porter. Right.

Mr. Himes. And my sense is that they are not close to that.

So what is their exposure and timeline with respect to get meaningfully more protected than we are to a chip shortage?

Ms. Porter. So I think you are hitting the nail on the head of what I was trying to express. I think that is true for any country. No one country is going to be able to control a supply chain.

What I think we want to do is understand what is our goal here, given that it is so intertwined. Even if China weren't in the picture for a moment, let's say we had a whole bunch of other countries and nations that we still have to pay attention to in terms of our interaction and our engagement in this domain.

This is why I was advocating for the development of standards, because standards allows everybody to come to some kind of agreement about what is going to be measured and what everyone is going to be held accountable to.

And we have to face the reality that with less than 5 percent of the world's

population, our influence has to be through measures like that, versus trying to say that we are going have the majority of manufacturing in the United States or the majority of sourcing of chemicals and gases in the United States or whatever.

To your point, China also will have to come to grips with the fact that this is an international, intertwined industry. And the more that we control it, the more they are going to have to come along and deal with that or retreat and suffer the consequences.

And they may retreat. But to your point, I think if they retreat, that will hurt them ultimately, because this is an intertwined industry.

So I can't speak to what China will do. But I do think that the United States has to recognize that we should be participating strongly in this industry and trying to shape and guide the standards by which it manufactures those chips. And part of that is the resilience question that we were taking about earlier.

Mr. Isaacs. If I could just jump in.

China is seeking self-sufficiency, but they have a ways to go. Again, I can't quantify it, but they are very much dependent on the U.S. and other Western nations for key manufacturing equipment.

As Chairwoman Speier mentioned, these are highly complex pieces of equipment that have thousands of components and lots of embedded technology. They can cost upwards of $150 million each and there is in a fab dozens of these.

So they rely on us for equipment. They rely on the U.S. for the electronic design, automation software, and other IP. They are seeking to gain that knowledge both through homegrown growth and trade secret theft and IP theft. And they are dependent on the West for leading-edge chips as well.

Mr. Himes. So what from a threat standpoint, I mean, if you are sort of playing the chess game here, are they 1 year away from being able to draw up the drawbridge, 10

years away, 20 years away?

At what point do we worry that either a war or a global pandemic even worse than what we have just seen crushes us, but they are fine? What is the timeframe?

Because, I mean, you are asking us -- or somebody is asking us, apparently -- to spend $52 billion, which is an immense amount of money.

So what is the timeframe at which they can pull up the drawbridge and they are fine and we are in a lot of trouble?

Mr. Isaacs. I am not sure I can give a solid guess on that, but it is upwards of 10 years. And it might be never, because I think it will be very hard to be self-sufficient. And, again, we can change the paradigm by outrunning them, where they are always behind us, and that is what the goal is.

Mr. Himes. Well, okay. Thank you, Madam Chair.

I mean, that is interesting, because, again, we are being asked to spend $50 billion right now. And you just said they may never reach the point of self-sufficiency -- from which I might infer that we might never reach the point of self-sufficiency.

I mean, I haven't looked at this bill, but I am deeply skeptical of industrial policy, especially industrial policy that you probably can't win with if you can't lock up 100 percent of a supply chain.

We have done R&D superbly. We haven't done -- I mean, this feels to me -- I don't know this bill -- but it feels to me like we are going to give a ton of money to the semiconductor industry for fuzzy outcomes at best.

The other thing I worry about -- and I would just invite comment maybe from you, Mr. Hunt, because you were a proponent of the bill -- 10 years, Mr. Isaacs said 10 years maybe, if they are lucky, I guess I interpreted that.

Semiconductor technology and semiconductor manufacturing is going to look

nothing in 10 years like it looks today. But we are going to spend $50 billion today. This pace of innovation is such that my natural skepticism about industrial policy is exponential with respect to spending money now on buggy whips when 10 years from now we are not going to be using buggy whips.

So go at it.

Mr. Hunt. Thank you.

Yeah. So I absolutely agree that we don't want to end up in a race to the bottom where everyone is competing to put more and more subsidies into the industry and we don't get any outcomes.

I think the goal, in my mind, of the CHIPS incentives is actually to level the playing field, because right now in East Asia we do have a huge amount of subsidies going to semiconductor firms. And that is a huge driver, as the Semiconductor Industry Association has assessed, of the consolidation in one very specific part of the world, which does cause risks, not only for the United States, but for many countries.

So I think I would ideally like to see us engage countries like Taiwan, South Korea, and even China, to try to negotiate down these subsidies.

But I think we are in a stronger position to have that conversation if we take the initial step of investing up front and showing that we are serious, and then also trying to address the immediate reality, which is the very real economic and national security risks that we are facing because we actually can't make leading-edge chips in the United States right now.

Ms. Porter. And if I could add to that, sir.

I share your skepticism. I think I am in the minority in this room on that. But I am actually very concerned about spending a lot of taxpayer dollars in a subsidy kind of environment.

I have actually looked at 10-K's of our industry and I invite you all to do that and look at how much free cash flow certain companies that will benefit from this actually got in 2020, and how did they spend that money, and why aren't they spending it here, for example.

So I actually share your concern. And that is why in my testimony I cautioned very strongly against just putting subsidies on the supply side. And that is why I ask, even if you could build a TSMC clone in Arizona or anywhere else, so what, if I gave that to you for free?

If the demand signal doesn't want it, if you are not talking to the design houses and the other customers, the Apples, the Qualcomms, AMD, et cetera and so forth, what do they want? What is going to change their mind? They drive this industry.

And to Mr. Mullin's question, that is why I think you have to have this hearing as well, because the Department of Defense and the IC do not drive this industry. They just do not drive it. So if they think they are going to be able to do something special off to the side, all they are going to do is isolate themselves from the state of the art that is going to be driven by the commercial sector.

Mr. Isaacs. If I could jump in. Just a brief comment.

First of all, the goal here is not to be self-sufficient. The goal is to promote our national security and our supply chain resilience and our economy by having core capabilities that we need onshore so they are more secure. We are not advocating self-sufficiency. And we very much need to leverage the goal of supply chain and will continue doing so in the future.

The funding for CHIPS is vital because it would provide that onshore capability. Yes, the companies are healthy, but that is not the point. The point is that it is more expensive to build and operate in the United States versus overseas.

Chairwoman Speier. Isn't that always going to be the case?

Mr. Isaacs. Well, not if we step up and incentivize and reduce that cost differential. Maybe we don't fully eliminate it, but we get close enough. And with the companies that Dr. Porter mentioned, the design houses, the big players, Amazon, Apple, they have an interest in having leading-edge capability diversified and have their supply chain diversified with capabilities in the United States and elsewhere and not have everything concentrated in one locality.

Mr. Himes. I guess I am -- with the grace of the chairwoman -- I guess I am still struggling.

So, Mr. Hunt, you talked about leveling the playing field. As a policymaker, I wonder, okay, apparently we can spend $52 billion to help level the playing field or we can go to the WTO and try to level the playing field the way we try to level the playing field in every other product that we don't spent $52 billion.

Mr. Isaacs, the reason I am puzzled by what you just said is you said this is about national security. But then you say it is also not about self-sufficiency. To me, that feels like you are buying 90 percent of what you need, without that other 10 percent.

In other words, if you tell me we need self-sufficiency, I get it, let's find self-sufficiency. I don't know what you get if you got 90 percent of a chip that goes into an F-18, but you don't have that other 10 percent. It feels to me like you either get self-sufficiency for your $52 billion or you are just throwing away $52 because that 10 percent is not there and you are done.

Mr. Isaacs. Again, I think we have a globally integrated supply chain, and having capabilities in allied countries is a strength of the United States, and we are not looking to displace that.

But, again, there are core capabilities for the Pentagon, the IC, critical

infrastructure that we should have onshore.

I think the experience with the pandemic taught us this. What we are seeing now with the chip shortage in various industries is highlighting the need to increase our capabilities onshore, both for economic reasons, but also national security and supply chain reasons.

Mr. Himes. Thank you.

Thank you, Madam Chair, for the double time.

Chairwoman Speier. You are welcome.

Mr. Isaacs, you referenced that TSMC is actually going to build a plant in Arizona. Can you tell us more about that?

Mr. Isaacs. Yeah. They announced several months ago a leading-edge foundry in Arizona, and I believe they have purchased land and maybe have broken ground. I don't know the exact status. That is a very significant development.

Again, other companies, Samsung, Intel, others, have announced either new fabs or expansions, again, partly in expectation of the CHIPS Act getting over the goal line, I believe.

I think all that activity is very important. I think the chip shortage is showing that the industry is growing. This is not propping up a failing industry. This is having the U.S. maintain a leadership share of a growing industry.

Chairwoman Speier. I would like to shift gears to the talent pool.

In terms of the graduate students at universities around the country, two-thirds are foreign born. They come from India and China for the most part. We aren't growing them internally.

So as Mr. Himes was referring to this $50 billion, I am wondering how much we should be spending of that kind of money to create the linkage between students in high

school and early college to kind of move into these career paths so that we can stimulate more homegrown talent.

Do you have any thoughts on efforts that have been undertaken in other countries or in other places that you think are particularly noteworthy?

Ms. Porter. So, ma'am, the thing that worries me the most actually is that for a long time we have been seen as a beacon for foreign nationals to come and study. That percentage you quote, I am not sure if you are aware of this, but of the people who come here, historically over 80 percent stay, and they provide the lifeblood for this country.

Arguably, my grandfather was a foreign national when he came here. So we all come from foreign countries. And I think there shouldn't be an either-or. I don't think it is a homegrown versus foreign national. I think we want to be the beacon for the best and brightest and encourage those people to stay here.

If you look at the CEOs of many of our major companies, they are foreign national, first generation, et cetera. And I have known some amazing folks, frankly, from China who have come here and stayed here and chosen this country as their country, and the same with India. And they are very proud of that.

So I get a little concerned about rhetoric that tries to divide people who were born here versus people who want to come here and make this their country. And that is why I keep emphasizing the 5 percent of the world's population.

Given that plain statistic, there is no way we are ever going to have a monopoly on the best and the brightest worldwide. That is not possible.

So we have got to attract them. We have got to be the place where the best and brightest choose to come, even if they are not born here. And I think a lot of our attention should be focused on ensuring our policies encourage that.

And for those who worry about leakage and the risk, again, you can't live in a

zero-risk environment. Yes, you have to, of course, put in place some smart things to make sure that people aren't taking nefarious advantage of that.

But the vast majority of those people come here because they want to make this their home and they want do well here. And that is what makes this country great.

So I am sorry to be so passionate about this, but I do get concerned when people --

Chairwoman Speier. No, I appreciate that. But our numbers have been stagnant in the United States since 1990. So I am interested in seeing what we can do to augment that. Or are you just saying that that is the --

Ms. Porter. It is a good question. I just didn't want to put it as a contrast. I want to say that I think the fact that we attract the best and brightest is an additive component that really gives us a huge advantage.

For those who are in high school and pre-high school, I agree with you, it starts early. I was encouraged from a very, very young age by my parents. They didn't understand me, because none of them were in science and tech, but they encouraged that in me.

And I agree with you that there is a lot that can be done even within our borders, which is why I emphasize both within our borders and outside to attract them into this industry and related technology industries. Totally agree with you on that.

I just didn't want there to be this implication that because a lot of our talent comes from outside, that is somehow a bad thing. I think it is a great thing that they come and choose to stay here.

Chairwoman Speier. Anyone else want to comment on how to stimulate more homegrown talent?

Mr. Hunt. Sure, yeah. I have a few different recommendations on workforce

development.

I absolutely agree with Dr. Porter about the both and not an either-or approach to talent.

First, we have to address the fact that many R&D jobs in microelectronics do require the graduate degrees that foreign-born students are inclined to get more than American students.

And it is often a choice. American students have the option often if they are STEM inclined to study software engineering and get a B.A. and then earn as much money as someone with an M.A. or an M.S. in microelectronics or something related to microelectronics.

So I could see a lot of benefit in, say, a 4+1 program in semiconductor-related disciplines where you could accelerate progress to a master's degree, maybe you could incentivize that somewhat so that the cost differential is a little more even.

But a second point. Taiwan has done a really good job, I think, of getting co-ops and partnerships between the private sector and schools.

So right now there are very few universities that have, like, fab equipment, this very expensive equipment. So you can't actually get hands-on experience if you are studying electrical engineer in microelectronics.

So that is another deterrent. And I think you could see partnerships happening there that give access to that equipment.

My third recommendation is in support of the first two, and that is that I recently wrote a report on the workforce and I found that it is quite difficult to measure the workforce. The numbers that we have available do not always point correctly to whether you are a microelectronics worker or not.

So improving measurement so that we actually know whether we are succeeding

on the goals we set for ourselves is also really important.

RPTR SINKFIELD

EDTR CRYSTAL

[11:08 a.m.]

Chairwoman Speier. All right.

Mr. Isaacs.

Mr. Isaacs. Just a couple of quick points.

Number one is that funding of research is really funding investments in our people and will attract the graduate students in these fields. And so I think that is critical.

Number two, under the CHIPS Act that we have been talking about a component or requirement of receiving a grant is a workforce development program. So that will be built in where the companies need to engage in workforce development efforts.

And, number three, the legislation that the House Science Committee passed and that the full House passed, I believe earlier this month, includes some very promising endeavors, like allowing funding for hands-on technology learning, things like robotics competitions. And we at SIA work very closely with FIRST Robotics and are very encouraged by initiatives like that.

Chairwoman Speier. All right. I have one final question. Anyone else have anything further?

As we look to the future of state of the art microelectronics, what role do artificial intelligence and machine learning play in chip design and chip verification? Any thoughts on that?

Dr. Porter looks like she --

Ms. Porter. I am smiling because DARPA has been looking at that question, and it is a really smart question.

I think it is going to play a role. I think you are going to see -- and again, this gets to the point that David was making about R&D.

One of the things our country does so well is through DARPA and IARPA and places like that. That is where the really cutting -- we take risks. We are willing to try something.

And it might not work, but that is okay. We are going to put our best minds on it. And if it does work, it then allows us to outrun, as David says, and I fully support that thought.

So in the case of DARPA, they are looking right now at just your question: How can artificial intelligence be used as a tool to accelerate chip design, and, in fact, to potentially democratize it? And what would that do?

So there are a lot of open questions. AI has still got a lot of kinks to work out, as I am sure you know from other hearings that you have had.

But I am very excited about that kind of work. And I think, to the extent that acts like the CHIPS Act and others look to how do we ensure we are investing in that cutting-edge research, it is a good use of taxpayer dollars.

And I will say, in my prior job in the Department of Defense I got to travel internationally, and everybody, every country is fascinated with DARPA. They all know about DARPA. They all know. And they all want to create their own DARPA.

And, by the way, I have yet to know of any country that has successfully replicated it, because the culture and innovation of risk-taking that we have in America that we take for granted is not present as it is here.

And so to the extent that you -- I mean, that is such a great question, because that is exactly the question DARPA is asking. That is where we want to be pushing ourselves, is how can we use our technology to outrun, to jump ahead of our competition, and then

run with it because of our free market and other principles that allow us to turn that into scale and product?

Chairwoman Speier. All right.

Anything else? All right.

Well, this will conclude our committee hearing.

Mr. Hunt, Dr. Porter, Mr. Isaacs, thank you very much for being here and participating, and to my colleagues for being here. And we will stand adjourned.

[Whereupon, at 11:12 a.m., the subcommittee was adjourned.]