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The Role of Global Standards in the Battle for 5G Leadership

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TRANSCRIPT

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THOMAS J DUESTERBERG: Good afternoon, ladies and gentlemen. It's a pleasure to welcome all of you to the Hudson Institute on this beautiful winter day here in Washington. We're here to discuss the role of standards and the standard processes in the competition to roll out 5G systems around the world. This is a subject of considerable economic, national security and political significance. 5G standards are important not only to the communications sector but to emerging technologies, such as artificial intelligence, the Internet of things and autonomous vehicles. The role of export controls in affecting our ability to participate in international standards-making processes is front and center to our discussion today. We have a distinguished group of speakers to cover each aspect of this issue, so I'm not going to dwell on it from the podium.

We're going to start with the keynote address and then have a panel discussion followed by questions with the audience. And I think we have passed around a basket which has a form where you can write down your questions so that we can have an efficient Q&A session. So pass them over to Patrick or one of his colleagues when you have written down your questions. Finally, I want to thank Qualcomm corporation for support in making this event possible. Our keynote speaker is Robert Strayer, the deputy assistant secretary for cyber and international communications and information policy at the U.S. State Department. Rob's ideally suited to address the many issues involved in this discussion. He has led U.S. efforts to keep the U.S. influential in the International Telecommunication Union and has worked with dozens of U.S. allies to win better understanding of the many economic and political issues involved in the development and rollout of 5G systems around the world.

Before coming to the State Department, he was general counsel of the Senate Foreign Relations Committee, where he advised the chairman on questions related to cybersecurity and the digital - and digital economic policy. Earlier in his career, he worked on cybersecurity legislation as counsel and Republican deputy staff director in the Senate Homeland Security and Government Affairs Committee. He practiced law - communications law at WilmerHale from 2002 to 2005, specialing (ph) in telecommunications. Rob received his J.D. from Vanderbilt. And we're honored to have him with us for this event.

(APPLAUSE)

ROBERT STRAYER: Good afternoon, everyone. I want to thank the Hudson Institute for hosting this topic - this discussion on this timely and topical subject. And, Tom, thanks a lot for that introduction. And it's particularly important we're talking about 5G and spectrum policy and standards on the heels of the recently concluded ITU World Radiocommunication Conference that was held in Sharm El-Sheikh, Egypt, where the world came together to consider global harmonization of 5G spectrum. Those outcomes help illustrate a few points regarding the importance of global standards in American leadership in 5G. The WRC concluded on November 22. In the end, the conference identified 17.5 gigahertz of additional millimeter wave spectrum for 5G. This builds on an existing 1.9 gigahertz of spectrum that was already identified for 5G use prior to the World Radiocommunication Conference. Of this new 17.7 gigahertz, almost 15 gigahertz is globally harmonized. Why is that important? Well, global harmonization of this spectrum brings the possibility for economies of scale, lowering deployment costs for providers and device costs for consumers. When operators are deploying 10- to 50-millimeter-wave 5G base stations for every one of the existing macrocell sites of 4G and 3G base stations, those deployment costs will truly matter. And then when every country is racing to be the first to take advantage of the benefits of 5G, rapid deployment and rapid adoption are very important.

These decisions help set the stage for an ecosystem of equipment and devices that can operate across various ranges of spectrum in these upper-level bands.

Importantly, our efforts helped ensure that the outcomes from the WRC aligned with U.S. actions already taken by the Federal Communications Commission as part of its 5G FAST Plan regarding 5G options - auctions and licensing in these upper-level bands that will be critical for 5G. Compare - the spectrum identified for - at the WRC '19 compared to the spectrum identified in the FCC 5G FAST Plan are nearly identical. U.S. has already auctioned or will auction spectrum in 24-gigahertz, 37-gigahertz, 39-gigahertz and 47-gigahertz bands. And because we are further ahead in the auction pipeline for these bands, the United States will lead in the commercial ecosystem built for millimeter wave 5G markets. The upshot is that our engagement at the WRC has positioned the United States to be able to set the pace not just for the equipment that will be developed but the services and applications and business models that will ride on top of that - of the very important 5G ecosystem. This is just one instance in the way that global standardization helps to drive the market. And this is only one way in which the United States must engage in shaping the global standards that will drive the next generation of emerging technologies. Standards, indeed, shape markets. Standards ensure safety, quality, reliability of products and services, as well as their interoperability. Standards help overcome barriers to trade and support the global economy. In the 5G world, standards play a key role in the development of equipment and consumer devices. They help ensure the interoperability of equipment and to allow for innovation and for competitive markets.

Standards also allow for a competitive playing field across vendors and providers, as well as across countries, and that will all benefit consumers. Standards also allow industry to hold themselves accountable. The powerful forces of the free market can police substandard products or services, particularly when the standards themselves are fairly and transparently developed and readily accessible. The United States has long been a supporter of open, transparent, consensus-based standards processes. Our existing national standard strategy reflects the market-driven philosophy of the American economy. In short, our standards process is successful because the very groups that need these standards - that is, the stakeholders - decide what standards are needed, when they are needed and what will meet their requirements. Our market-driven, private-sector-led approach is substantially different from approaches favored in other parts of the world, including in China. Standards developing in the United States is a public-private partnership in which government participates alongside industry to drive the best technologies and solutions forward to reduce friction in trade and reduce cost to consumers. And to date, this bottom-up approach has produced a diversity of thought that leads to innovation and narrowly tailored standards relevant to the specific needs of industry. Let's take - let's pause a minute and look at what other countries' attitudes are toward standards. We are in an area - era of unprecedented international competition.

Other nations take standards very seriously because they understand their economic impact. Like the United States, other nations view standards as a way of reducing friction in domestic trade and improving national competitiveness in the global marketplace. Other nations place high value on the ability to set standards. One recent article I read quoted a popular Chinese saying as, first-tier companies make standards, second-tier companies make technology and third-tier companies make products. Nations recognize that standards are a critical element to technology leadership. The drive to shape international standards in China derives from its drive to become a technology powerhouse. While Chinese representatives were not at the table when

the Internet economy was initially shaped, the Chinese Communist Party seeks to advance its interests in 5G, AI quantum and facial recognition. The standardization for 5G technology is underway in a range of standards and specification organizations, including 3GPP.

These organizations have very different approaches and models for standards development. This diversity of approach is not at all bad. It works well when the bodies developing the standards are open, transparent and well governed. For technology firms in particular, it also means the ability to take technology they have developed and license it to the global market. Influence in standards-development bodies is becoming as important as influence in multilateral governmental organizations. So how should the United States government approach - engage on international standards, particularly for 5G and other emerging technologies? The United States Standards Strategy offers some thoughts. On a general strategic basis, the United States Standards Strategy states that all stakeholders in the United States' standards development process - particularly industry, standards developers and the U.S. government - need to devote more resources and greater efforts to helping stakeholders in other countries understand the U.S. process and its many benefits. U.S. stakeholders should promote policies and procedures in international forums that engage the development of standards that are voluntary, consensus-based, market-driven and globally relevant. Government should recognize its responsibility to the broader public interest by providing financial and legislative support and by promoting the principles of our standardization system globally.

Global competitiveness of U.S. industry depends critically on standardization, particularly in the sectors that are technology-driven. And that's all quoting from the United States Standards Strategy. But two overall thematic points occur to me when reading through that strategy. First, the standards strategy articulates quite clearly the market-driven nature of our standards process. Over my discussions with my counterparts in industry and government, I do hear the question of whether the United States must change its approach to meet the challenges coming from countries that would seek to undermine the approach that we have led for emerging and future technologies. I don't have the answer to that question today. But notionally, I think the answer is no. The United States is not and will not be a directed economy. We fully endorse a private sector - we fully endorse private-sector-led standards development process, just as we fully endorse the private sector's lead in developing 5G networks across the world. However, the United States - both government and private sector stakeholders will be foolish not to respond to the challenges presented by the competition from centrally planned economies that are planning strategically in these standards bodies. In order to respond, we must start with a solid understanding of the United States' level of participation in the standards development process.

We in the U.S. government are working with the private sector partners to take a close look at our engagement in standards organizations and our leadership positions, as well as where the Chinese engagement in leadership have been increasing. At this point, we have anecdotal evidence that private sector participation in some standards development activities has dropped off, while participation by non-like-minded countries has increased significantly in those organizations. The private sector and the government should partner to better understand the problem and its impacts so that we can continue to generate effective responses. The second thing that occurs to me when reading the U.S. Standards Strategy is that the document focused on two macro issues in standards development. The first macro issue is our recognition that governments should not themselves set standards and dictate technical requirements. Moreover, government should avail themselves of private sector standards when possible. The

second macro issue is the recognition that some countries have used standards as a powerful tool in their toolbox to create barriers to trade or protect access to domestic markets. However, our current concerns are not just about the efforts of some nations to utilize standards to obstruct trade, but also as a tool to unfairly advantage their companies.

As we develop our updated strategies and tactics to address this challenge, we need to clearly identify this new threat and provide a road map for mitigation. Our efforts to secure 5G leadership is a necessary collaboration between the government and the private sector. We really cannot do this without each other in deployment, in securing the networks and in standards development. 5G is an effort that will require all hands. As the world becomes increasingly interconnected, international cybersecurity and digital economy issues like 5G are becoming even more critical to national security, human rights and economic prosperity. 5G certainly will be transformative. It will be - it will enable connections that will empower a vast array of new critical services from autonomous vehicles to transportation systems to automated telemedicine to automated manufacturing. And the massive amounts of data transmitted by the Internet of things devices on 5G networks will also advance artificial intelligence. With so much of the future economy and national security potential relying on 5G networks, the stakes for safeguarding these critical networks could not be higher. I also want to be clear that standards alone are not the silver bullet to address fundamental questions of trust when it comes to the deployment of 5G technologies. You need to be able to trust the 5G equipment and software vendors such that they will not threaten your national security, privacy, intellectual property or human rights.

Trust cannot exist where telecom vendors are subject to an authoritarian government, like the People's Republic of China, that lacks an independent judiciary or rule of law that will prevent the misuse of data or disruption of critical infrastructure. This is why we're not only working to improve our engagement in standards development, but also sharing our concerns about the risk of untrusted vendors with our allies and partners around the world. While we often think of security and standards purely as technology issues or even an economic or global competitiveness issue, some of the challenge that have been raised are national security and foreign policy issues. Given what is at stake in 5G, we must prevent any entrusted company, regardless of its national origin, from supplying technology for 5G networks. This is in part because the software on any network can be instantaneously updated, and there's no way to test or certify your way to assure yourself that there's not a compromise inserted into that software that's been updated. We will continue our bilateral and multilateral engagements to ensure that telecommunications, the Internet and all critical services that 5G will enable are secure and reliable. And we must take a more strategic approach in how we look across the board at our engagement in global standards organizations. Thank you for the opportunity to speak today, and I look forward to some questions.

(APPLAUSE)

DUESTERBERG: Rob, I think that's the only microphone.

STRAYER: OK.

DUESTERBERG: Let me just start off by asking you one question. I know you've been racking up the frequent-flyer miles last year or two, going around talking to our friends, allies and, sometimes, our competitors about 5G and 5G standards. I can recall back in the - as long ago as the '90s, when different standards were competing for dominance in telecommunication.

There's a GSM standard. The Chinese tried to come up with something called TD-CDMA, if I remember properly. But fortunately, the best technologies won out in the long run. But they were - we saw assertions of national interest, if you will, in those battles as well. So how would you characterize the willingness of our friends and allies to work with the United States on assuring sort of a private-sector-led process, and how much do they share our concerns with some of our competitors?

STRAYER: Yeah. So standards in 5G can address some of the security issues in place in our partners around the world. And, you know, it's really been a global system that has formed up the standards for 5G that includes some security aspects to it. Those include authentication and configuration of the networks. But as I mentioned before, the fundamental concern is that when software can be instantaneously updated - and software forms a more and more important feature of 5G networks that improves the sort of performance, because we'll see network slicing, we'll see greater virtualization of functions of networks. Software is something that fundamentally can be manipulated from the inside by those producing the hardware in the form of the firmware they put on that hardware and the operating system. So we're communicating with the European Union and other partners around the world about the importance to having not just technical cyber standards in place, but having factors of trust that include looking at the legal regime where the supplier is headquartered.

And as I mentioned in the case of China, there's an authoritarian government there that does not have the rule of law or an independent judiciary to stand between the company and the dictates of the Chinese Communist Party. We think there's other indicia of trust that are country-agnostic and could be applied around the world, and those include looking at companies' past acts of respect for the rule of law. Do they have a history of corruption? Do they have a history of intellectual property theft? In the case of a company like Huawei, there's a lot of - there's a long history of problems in both those areas. I think it's important to look at is the company truly independently financed?

In the case of Huawei, we understand that there's the Chinese Development Bank, Chinese Export-Import Bank providing massive subsidies for their financing. And, lastly, one needs to understand the ownership structure of one of these companies. Is it transparently owned? Who, at the end of day, is really pulling the strings? Is it the Chinese Communist Party? Is it some other political entity? Or is it really the owners that are owning shares, say, in a public - format of a public-traded company? So I'm very optimistic about recent developments in the European Union, including by the European Union Council on December 3, saying that they needed to look at the legal and policy framework of where companies were headquartered and ensuring that those trust - that kind of trust was ensured, in addition to the nontechnical - or in addition to the technical measures.

DUESTERBERG: OK. We - Rob has to leave in about seven or eight minutes. We have time for a couple of questions. If you have a question, let me know, but I would ask you to be very succinct. Identify yourself. Be very succinct and ask a question. Don't make a statement. So the gentleman in the front row there.

AUDIENCE MEMBER: Just real quick - have you had a chance to look at the phase one trade agreement to see if there's anything in there that helps us with this problem?

STRAYER: I'm not the expert on the trade issues in our administration, so I'm not going to comment on it.

DUESTERBERG: OK. Well, the gentleman in the back.

AUDIENCE MEMBER: I have an interest in the big picture, which is where my question is leading. The way I see it, the playing field is set up. China's going to go one direction, and we're going to go the other. From the State Department's point of view, how do you see the sphere of influence changing in terms of developing aid and other places where China actually does have a lot of motives? And they're doing them, or they're actually implementing a lot of this in Africa.

STRAYER: Yeah. Well, let me just start on the standards point. We want China to be part of the global standards development process. And we invite everyone to join and participate in that process. It's important, though, that when countries join that they're not trying to put a thumb on the scale to favor certain technologies - can lock us into technologies that won't be as productive in the future. So, you know, our real goal is to see the best of standards development bodies. We also want to see the best when it comes to the uses of technology. We think that our democratic values are fundamental to informing how technology should be used, especially when it comes to facial recognition and artificial intelligence. Unfortunately, we've seen cases like in the Xinjiang province of China, where Huawei has worked with the local province on their security measures that include using facial recognition to identify Uighurs and then to imprison them in these internment camps. So that is a future for the use of technology that I think should cause the entire world concern. So our real point is we want to see the values lifted up for how technology should be used. And everyone should join that view about the appropriate use of technology, the importance of having the rule of law to vindicate individuals' rights as technology is deployed in ways that can become more and more invasive simply because the amount of data that's available about us and the rapid nature of the ability of computing to occur on things like 5G networks in cloud-provided services.

DUESTERBERG: Other questions.

AUDIENCE MEMBER: I wondered how in the world did we fall so far behind in 5G? And what role can the federal government play in helping to close that gap?

STRAYER: It's an interesting question. I say interesting because, in some ways, I don't think we are behind, you know? Huawei's put out a lot of PR effort to try to establish that they have a certain number of patents and they're - have a leading technology. They have technology that's competitive to others, but Nokia, Ericsson and Samsung are providing an equally - equivalent level of technology at a comparable price point at this point. So we think that they are providing - if you look at what's inside those, and I think you'll hear some on the next panel, it's key American semiconductors are providing the technology that's world-leading in this area. So we're not behind, but it would help if we had, I think, greater public-private partnerships to work on standards issues, and we can think about ways we could partner with the private sector more on developing areas where - I mean, emerging technologies where we see gaps in the future that we want to fill.

DUESTERBERG: I think we have time for one more question. The woman in blue here in the front.

AUDIENCE MEMBER: Chinese Communist regime helping propaganda that they would be leading in 5G area. However, the experts said the virtualization technology of wireless radio resources of the whole world is still in its infancy. There are still many major challenge to be overcome, such as wireless spectrum resources require more efficient management than

collaboration among countries. So could you elaborate the American superiority in 5G area? Thank you.

STRAYER: Yeah. So I just would point back to the initial remarks I made about the World Radiocommunication Conference in identifying additional spectrum that will be available for millimeter wave. Millimeter wave will provide the fastest level of throughput in sort of the most effective use in - when we see automated manufacturing or use of robotics, it will need millimeter-wave technology. I also think it's important to recognize that we're going to see leadership from U.S. microchip producers. We're also going to see more development of software-defined networks and virtualization of existing technology. 5G is not a static product. It's going to evolve over time. And American companies are already leading in the development of further virtualization of what they call the radio access network. Many parts of the core of telecom networks have already been virtualized - that is, made like a cloud. That will happen more at the edge. And there's American companies leading in providing that additional performance and functionality.

DUESTERBERG: Perhaps - we have some real industry experts for our panel. Please join me. And perhaps we can further explore these questions during our panel discussion. But thank you very much. And I would - please join me in thanking Rob for his...

(APPLAUSE)

DUESTERBERG: And I would invite our panelists to come up on the - and take their seats. Sit anywhere. Yeah, why don't you - all right. OK. I'm going to introduce each of our four panelists. They will have five to - five minutes or so to give some opening remarks, then we'll go to a discussion. And we will leave time for questions from the audience. I would ask you, again - I think you've been given a piece of paper. And we will pass out a basket or something in a few minutes with your questions so that we can keep this discussion going, succinctly. Our first speaker is Susan Armstrong, senior vice president of engineering for Qualcomm. She's had an outstanding record as a telecommunications and internet pioneer and as a practitioner of bringing new technology to market for Qualcomm, one of the leaders in telecommunications for over 30 years. She also worked early in her career on internet protocols for Xerox, I believe.

SUSAN ARMSTRONG: Yeah.

DUESTERBERG: She's served as head of worldwide customer engineering for Qualcomm, which integrates and commercializes the company's products and phones and other wireless devices. Now she is with its government affairs group, working to protect intellectual property, assure cybersecurity and educational diversity for science and engineering and technology students. Susie, the floor is yours.

ARMSTRONG: So wireless (inaudible) systems are extremely complex systems, and they require years and years of upfront R&D. You don't just float into the standards and participate at a technical level without that investment in R&D, making those inventions that can be contributed as technical contributions to the standards. And you need that R&D that contributes to the standards that then creates the blueprint, if you will, for the commercial products that then you need to actually deploy a system. So Mr. Strayer was talking about the U.S. leadership in global standards for 5G. And in many ways, that started many - for us in - at Qualcomm, that started years and years before, sometimes, five to 10 years before a system is actually deployed. So you cannot underestimate the power of standards to both the economic and the

national security of a global communication system. And in many ways, that standards' leadership is an involvement, is an indicator of a country or - and/or - a companies' R&D efforts. Again, you don't just float into the standards and make contributions without putting in that upfront investment in R&D that creates those technical contributions. From both a national and a cybersecurity point of view, standards' leadership is critical. Think of the standard as an architectural blueprint. The architects who design that blueprint understand that structure, that building at a very fundamental level.

Combined with the building developers - that is, the product developers, the commercial product developers - you have expertise if you lead in that standard and the R&D that creates that standard. You have expertise in the whole building or system, including its strengths and its weaknesses. So the standards, again, is an indicator of how much knowledge and how much expertise a company or a set of companies or a country has in that system. The other thing that is very important in standards - and Mr. Strayer touched upon it - is what we call governance in standards. You want to make sure that every country that can put in those - that effort on the R&D that contributes to the standards participates in those global standards. But you also want to make sure that the standards, if you will, remain a technical meritocracy. And the 5G standards are created in a body - a technical body called 3GPP. And those standards are adopted by the nations - you know, different nations' standards-development organizations as the standard for that nation and for the international corporation.

So it's very important that, No. 1, those standards be open and transparent, that every company and country who wants to participate can and that they make, you know, rational technical contributions that are then discussed and - in an open manner, and the best technology ends up winning. And there has been some challenges in that governance area in the past. And we can talk about that ongoing. Another policy challenge that we feel that has been happening recently is the chilling effect of having standards - the chilling effect on U.S. companies working in standards, like 3GPP, where there is a company like Huawei on the entity list. The unintended consequence of that is something that most people don't completely understand, and that is if companies - the way a standard is actually developed is companies do that upfront R&D, they bring in a technical contribution, and then all of the participating companies and countries discuss those technical contributions, decide which one is the best, and then bring it to the floor - usually for consensus rather than just a vote. And if U.S. companies are chilled from interacting with Huawei, for example, in the standard setting, that can cause - for fear of running afoul of export compliance rules, that can cause a chilling effect on standards. And we're actually on U.S. participation in standards. And we're actually seeing that in some cases because nobody wants to run afoul of export control rules. So we are looking - this is a very specific policy ask, but we are hoping, No. 1, to get clarification from Department of Commerce on what kinds of technical conversations we can have and what kinds of conversations we can't have and, hopefully in the long term, a standards carve out so that any global company, any U.S. company, can participate, regardless of who is in the room, in these technical standards discussions.

I think the last set of policies that I would like to mention is, again, standards are critical for national security, for our country's economic security, as Mr. Strayer said. And they arise, as I said before, from the R&D that you sink into those standards. And so having - making sure that U.S. companies continue to have a - access to global markets, including China, is very, very important. There was a question asked earlier over here about - or a comment that maybe

China and the U.S. were going to go different ways. And I don't think that's feasible, either for the U.S. or for China. You really want these marketplaces to be global. And you really want to make sure that that money that comes in from having access to a global marketplace continues to fund U.S. R&D. And so in closing, I'd just like to say that, again, it's critical that U.S. companies participate fully in standards. The standards are an indicator of that R&D that you sink in. And that understanding of the whole system, a very complex system as the architectural blueprint of your products, is really critical to making sure that you understand the security aspects and take full advantage of the economic aspects going forward.

DUESTERBERG: OK, thank you, Susie. Our next speaker - I'm pleased to welcome John Neuffer, the president and CEO of the Semiconductor Industry Association, where he leads the industry's efforts to shape a public policy agenda supportive of an industry which has over 45% global market share and some of the most sophisticated products in computer storage devices and telecommunications equipment. The next frontiers of artificial intelligence and the Internet of Things will expand the reach of the industry even further. John's career has included service at the U.S. Trade Representative, with especially in Asia-Pacific markets and at the Information Technology Industry Council. Prior to coming to SIA, he also has long experience in Japan, so he's an expert on the policies of - high technology policies in the East Asian markets. John, thank you for being with us.

JOHN NEUFFER: Thanks, Tom, for that. It's a pleasure to be here this afternoon. It's a pleasure to see some old faces out there. I see Gill (ph) hiding out back there and Stephanie (ph) over here. Let me just jump right into the export control piece of this which Susie touched on because it's very timely, and it's a very important issue for the semiconductor industry. And it's very relevant to this whole standards-setting question. So 5G - the future of 5G, the Gs - 6G, 7G - wherever it all goes, it all rests on semiconductor innovation. And we heard that from Ambassador Strayer here. He alluded to that. It's all resting on the foundation of semiconductor innovation. But our innovation is very much - our ability to innovate in this industry is very much tied to a robust and global standards-setting operation. And if that's not in place, we can't innovate to the degree that we are today. There's a couple of pieces to this. The threat of export control is not export control themselves; it's overly broad export controls. And very concretely for us, sometimes overly broad export controls can lead to displacement of market shares to competitors in other countries because there's foreign availability of chips - when, for example, there's controls on Huawei, then other countries - makers in other countries can sell their chips to Huawei, and Huawei gets what they want, and we just lose our market share. That's one example.

But another example is what Susie was suggesting is - overly broad export controls can make it very hard for collaboration and cooperation in the global standard-setting bodies. The way it works is technical folks from our companies go to these standards-setting bodies and, with these export controls in place, sometimes they have to have a lawyer sitting next to them to tell them what they can engage and what they can't engage on. Things that are public - basically, there can be engagement, but what's public is actually questioned. So it raises lots of questions, and it makes it - it gums up the gears of standards-setting in the global bodies. So we're advocating a more narrowly-focused approach to this. And actually, very specifically, folks over at the Commerce Department in BIS, we would like an advisory opinion to give us some guidance on how to actually function in these standards-setting - global standards-setting bodies so that we can more effectively work to build out these global standards which underpin

our ability to compete and lead in 5G. One other point I'd like to make is that - Susie mentioned this, too - is that R&D is the backbone of the semiconductor industry. Roughly one dollar in five in sales goes back into R&D. Roughly 20% of our sales goes into funding R&D. That's right up there with the pharmaceutical industry. We're among the top R&D intensive industries in the world. Now, how do we - you know, how do we get that money to pay for the R&D - roughly $40 billion a year? Well, there's a big world out there.

Eighty percent of our consumers are overseas. And it's all about scale. If we don't have scale, we don't have money to pay for R&D. And one of the things that creates all that scale is that we have a global industry, and we have global standards to drive that global industry. And if we end up driving in a direction where there's balkanized standards, then we don't necessarily have the scale we need to dump back into the R&D to keep us innovative and to drive 5G development and beyond. So it's all connected, and this all has to work correctly. And if export controls are put in place in an overly narrow way, things get gummed up. The - kind of the high-level perspective I want to leave you with these introductory remarks is that, you know, it's up to the U.S. government to determine what our national security concerns. And we'll, of course, support U.S. government efforts in that regard. But as the U.S. government is making decisions about its national security priorities, what we're asking the U.S. government to do is just make sure - contemplating what those decisions mean for the semiconductor industry because our vitality - our ability to lead and compete around the world itself is a national security concern for the U.S. government. Thank you.

DUESTERBERG: OK. Thank you, John. Our third speaker is Jeremie Waterman, the president of the China Center at the U.S. Chamber of Commerce. Jeremie is also a graduate of the U.S. Trade Representative Office, where he worked in a whole variety of important trade issues. He also has worked at the U.S. China Business Council for five years. He directs the chamber's policy initiatives in China, Hong Kong, Taiwan and Mongolia, and also steers the chamber's policy work in the Asia-Pacific region. He's a graduate of the Johns Hopkins - Fletcher School, oh, my God. Close enough. I knew I should have written that down - the Fletcher School of Law and Diplomacy. Jeremie.

JEREMIE WATERMAN: All right, great. Thank you very much. A lot has already been said, and I don't want to - I want to avoid repetition. And I'll do my best to do that, although I probably will, I think, touch on some of the same points - excellent points - that John just made and also Susie. You know, the chamber and our members, we come at this from the perspective of, obviously, wanting to continue to grow the U.S.-China economic and commercial relationship in a mutually beneficial way. I think there's a recognition that up and - up to this point, it's not been as mutually beneficial as it could be. And so, obviously, we're very pleased about the announcement of a Phase 1 deal. There are some things we don't know. We're looking forward to learning more details, but that's the general frame with which we approach these issues. I would also say that we're here today, in all candor, because there is a challenge, and that challenge in part stems - really, there's two components to that challenge. There's a - there is a component of the challenge that is tied to China and some of the things that China is doing, sort of the uniqueness of the China model. There's also, I think, some things that we have not been doing as well as we could be here domestically, and that's really about the U.S. getting its own house in order.

In terms of the China component, Deputy Assistant Secretary Strayer, I think, alluded to a number of those issues. And I think speaking for the chamber, we would not disagree with a

number of those concerns. I think to China's credit, China has prioritized industries like 5G as well as others, and we can see that. We can see how China has prioritized a leadership role in emerging technology and foundational technology through policies like Made in China 2025 and many others. It's also, I think, fairly clear - and we've written a fair amount about this at the chamber - that China has moved in certain areas to deny market access and to preserve the Chinese - or lock up the Chinese market for domestic Chinese competitors in a range of areas. And now, increasingly, China is pairing that approach, which involves a range of regulatory tools, with an assertive outbound strategy, an outbound strategy that includes the Belt and Road Initiative, building new institutions, including in the standards area, and supporting those efforts with significant financial and other resources. So that is the challenge, and obviously 5G is a - in some - is a big part of that but in some sense almost a microcosm of the challenge. And I think there are questions about how the U.S. government and how the private sector are going to - are responding and are going to respond over the coming years to that challenge. And so just a few brief thoughts before concluding my opening remarks about - you know, what is the - what is that response, and how does that response need to evolve. The first point - and I think the previous presenters have already alluded to the importance of the U.S. continuing to support open, voluntary, and consensus-based approaches to standards-setting - in essence, to continue to support that market-based approach to standards-setting and ensuring that there is good governance as embodied in those principles with regard to global standards setting.

The second point I'd make is that it's critical - and I think this has been touched on as well - that U.S. IPR policies continue to promote innovation and to continue to promote what our innovators do best. And that includes ensuring that there is a whole of government consensus around these issues. We can't have different agencies with different positions on these critical issues. We can't have Patent and Trademark Office saying one thing and our Department of Justice and Federal Trade Commission - and sometimes even the Department of Justice and the Federal Trade Commission don't agree - saying different things. So we need to have an approach that continues to promote the great work of our innovators. Third thing the U.S. government, I think, needs to do is obviously continue to work with allies. And there, I think, we have not done as much as we can do and as much as we need to do going forward. And standards setting is part of that, coordination on critical issues of investment screening, of export controls and so forth. We need to do much more work with our allies, incentivizing them to work with us as opposed to driving them away. Another area that more needs to be done is in the trade space. And I think that's why not only the chamber, but if you look at the position papers of the National Association of Manufacturers, the Business Roundtable, we all emphasized in our statements to the administration the priority we attach to many of the issues that have now been reserved to Phase 2 in the trade negotiations. The issues related to level playing field - in particular, standards-setting, antitrust, the whole - the range of issues around data and cyber, how China is using its patent system. And Deputy Assistant Secretary Strayer alluded to some of the challenges around the absence of rule of law. Those are issues that go - cut directly to this issue that we're talking about today in terms of standards setting.

And it will be very important - as much as we recognize the importance of Phase 1 and welcome the announcement of a Phase 1 deal, it will be important that the two governments not spend too much time in congratulating themselves on Phase 1 and move to that Phase 2 negotiation as soon as possible because those are really important issues to the business community and again, to the kinds of issues that we're talking - the issue that we're talking about today. And the last point I'll just make - and again, it's really the point that John made - is we need to avoid

unforced errors when it comes to issues like export controls. And the - it's not to say that we don't support - we very much do support national security, and there are good reasons, at times, to use U.S. export controls, but they have to be appropriately calibrated. They have to appropriately balance national security with commercial opportunity. And we see that not just in this issue of standards-setting and - around Huawei's addition to the entity list, but we see it also in the ICT supply chain order and the breadth of that, the implementing regulation where the Commerce Department is now soliciting input on that order. We see it in some other discussions that are ongoing around the issue of de minimis and the foreign product rule. It's really important that these issues get appropriately calibrated so we aren't doing - we aren't inflicting self-harm. We need, as John said so articulately - our companies need access to the global marketplace. That scale that we have - that our companies obtained goes to R&D, and that goes directly back into our own national security. So I will leave it there.

DUESTERBERG: OK. Thank you, Jeremie. And finally, I'm very happy to welcome my colleague Harold Furchtgott-Roth, a senior fellow at Hudson and director of our Center for the Economics of the Internet. I first got to know Harold when he served as chief economist at the House Committee on Energy and Commerce. He was one of the architects of the landmark 1996 Telecommunications Act. He later served as commissioner of the Federal Communications Commission. Harold took his Ph.D. in economics at Stanford - and I think I've got that one right.

HAROLD FURCHTGOTT-ROTH: Yes (laughter).

DUESTERBERG: And he's an expert on competition law as well as the economics of the communications sector. Harold, the floor is yours.

FURCHTGOTT-ROTH: Tom, thank you for that very gracious introduction. I'm going to talk about, essentially, the economics of standards development organizations. Some people call it standards-setting. I prefer standards development. Its - standards get developed not at one point in time, but over a long period of time. These are not abstract concepts. If you go down to Pennsylvania Avenue and instead of looking to the left, you look to the right because you're used to cars driving on the left, you might get run over by a car. So the standards are really very important, and they're not necessarily new. Naval standards about which way ships would go across each other or in a report, those go back millennia. But standards developments have become much more important in the past century. The first one in the radio space was a radio conference in Berlin. I believe it was in 1906. There were actually several dozen countries from around the world that went to this conference to develop standards for the allocation of spectrum. It was the first radio conference. Standards development organizations exist both at the national level, at the international level. Historically, they were engineers meeting to develop technical (ph) standards - just engineers, just to develop technical standards. It was not - there really weren't a lot of political overtones, really wasn't even necessarily a lot of identification of the engineers by country.

They were just the brightest people who got together to work on developing new standards. And you could - they weren't just the developers. They were also the implementers. You can divide the technology world into the developers - the ones who are actually developing the technology - and the implementers - the ones who license the technology to create products that they then sell to consumers and businesses. And the U.S. historically has had a lot of representation both by the developers and a lot of representation by the implementers. And the U.S. is very strong

because technology is very closely related to intellectual property rights, and the U.S. historically has had very strong intellectual property rights. Brightest engineers from around the world over the past few decades - where do they want to come? They want to come to the United States. They want to come to Silicon Valley because that's where you can make your mark. That's where you can do great things. As Rob was describing, the importance in the United States of letting the free market rule, that has been the way things have been, and it's worked very well for the United States. We now have a different view of the use of these standards development organizations, which is perhaps, they can also have a political dimension; perhaps they can also have government influence on it. And it's really a struggle.

It's a struggle between, does the free market work, or does centralized planning work? And that is the big decision that has to be made. The U.S. has been very much wedded to the free market. We don't really have a national strategic economic policy. That's not how the government works. We're not - we wouldn't be very good at it if we did. I can assure you of that. But we're confronted with, does central planning work? And the concept that central planning can work for technology has never been proven. And so this is a great intellectual struggle, if you will, between, do free markets work for technology, or does central planning work for technology? Part of the answer also depends on intellectual property, and standards-setting organizations have been very important for two key concepts - standards-essential patents and the fair, reasonable and nondiscriminatory terms associated with standards-essential patents. Do those patents, which often come out of these standards bodies - are they - they're essentially like blanket compulsory licenses, which is not necessarily a good thing. It's really not a good thing at all. If you're a developer, you don't want to be under a compelled license. But if - it - in the days when it was just engineers getting together, they would figure this out, and they figured it out, actually, in a very efficient, reasonable way. When governments get involved in these bodies, you can use these for very strategic purposes to impose costs on competitors in a noncompetitive way, and also to benefit your national champion, if you will.

An interesting development in this is in the antitrust law. For the past 10 years, roughly, antitrust authorities around the world have looked at standard-essential patents and the FRAND - the fair, reasonable, and nondiscriminatory terms - and would use antitrust law to enforce the FRAND terms. There's been a little bit of a sea change in the past couple of years. Assistant Attorney General Makan Delrahim, who actually was speaking just right here yesterday, has taken a different view, which is kind of called the new Madisonian approach, which is to say, no, the real antitrust problem may be going on at these standards-development organizations, and we're going to look at those to see if they're being used in some noncompetitive way, which could be interpreted as well as to mean by governments. And so this new antitrust look at the standards-development organization - I think it reflects two things. One is, there is incredible economic value that's going on in these standards-development organizations that they are attracting the attention of government officials, and second, that they can be used in noncompetitive ways, and it's very important to get back to a world in which they're not used in noncompetitive ways. Let me just close by saying that, to some extent, this - the intellectual exercise, if you will, is, does central planning work for technology, or are free markets the best solution for technology?

And to some extent, the U.S. government has just been completely laissez faire about this forever, and there are some times when we need to be sure we're not just tripping over ourselves. I think Jeremie made a good point about coordination among different government

agencies to be sure they're not saying different things. And so here we have the assistant attorney general for antitrust saying, you know, I need to look at these standard-development organizations to make sure they're not engaged in the anti-competitive things, and we have another agency of government - the Department of Commerce - that unwittingly may be precluding American companies from going to participate in these very important standards-development organizations. And I think Jeremie's exactly right. We need to have much greater coordination among the government agencies, not to create some sort of centralized planning. We're completely incapable of that. But we need to be sure we're not shooting ourselves in the foot by accident every time we - any agency does anything.

DUESTERBERG: OK. Thank you, Harold, and thanks to all of our panelists for sticking to the five-to-seven-minute rule. So let me remind you to get your questions in to one of our colleagues. I've got a few questions to start with. Susie, we - one of the questions for Rob Strayer was - sort of alluded to a popular trope that the U.S. is falling behind China in 5G. What is the reality out there? I've seen numbers that - at the 3GG (ph) standards-making exercises in the last couple of years that China - Huawei has offered up around 40% of the proposals for new standards, but there have been questions about the quality of those proposals. What is the reality, in your view, of where U.S. firms like Qualcomm and like many of the semiconductor firms and radio network firms - are we behind, or are we still setting the pace?

ARMSTRONG: How much time do you have?

: (LAUGHTER)

DUESTERBERG: Well, two minutes.

ARMSTRONG: OK, two minutes. So as Tom mentioned and Mr. Strayer also mentioned, there's been a number of articles about who's leading in 5G, looking at where - for example, where networks are being deployed first, looking at the number of patents that are held, looking at the number of contributions that are made. It's important to note that patent - contributions can be anything from editorial - you know, crossing the T and dotting the I - to a significant technical contribution. Even those technical contributions are of different - they're all - it's a very complex system, so they're all on different aspects of the system. Some are important and small. Some of them are important and large. So, you know, patent counting and contribution counting is absolutely not the right way to look, nor is deployment time the right way to look at standards leadership.

So the way to look at standards leadership is to look at, again, to look at the value of the technical contributions that are made in the standards organization, and that's also, you know, an indicator of who's putting in that R&D.

If you look at 5G - if you look at 3GPP and the 5G standards, the main companies that are contributing at that foundational technology level - the inventions at that level that supports, you know, the chipsets and the base stations and the phones that are built off of them - it's Qualcomm, it's Huawei, it's ZTE, Samsung and NEC and Ericsson and, to some extent, Nokia. And all of those companies have - or most of those companies have a presence in some of the commercial products that are built - some or all of the commercial products that are built on top of those foundational technologies. So again, I think you have to look at who is contributing and getting accepted, the technical contributions and who is driving what we call at Qualcomm the systems work. We have - we at Qualcomm, we've had a major position in every G since 2G -

2G, 3G, 4G, 5G - as the innovator of that technology, the contributor to standards, and then putting out - we used to make base stations and phones as well - putting out the chipsets that go into primarily the mobile-side devices. So you can't look at patent counting. You can't look at, necessarily, the time of deployment. You really have to look at the value of those technical contributions and who is working with these company - with these companies and countries worldwide to roll out that technology and who understands that blueprint, if you will. Specific to Huawei, Huawei is very competent, and they make - but they make a lot of editorial contributions and are quite happy to, you know, count those in the press, as well as technical contributions to these standards.

NEUFFER: Just very quickly - just a very short note just to put things into context. I used to work some standards issues years ago - 10 years ago in a previous job, and we were constantly beseeching the Chinese, please don't develop your own unique standards. Please join the global standards bodies. And I guess you've got to be careful what you hope for because now they're kind of surging - swamping the system, and that's causing some heartburn.

DUESTERBERG: Do you have other examples, apart from 5G, where the Chinese are - you used the term swamping the system? But we - one of our colleagues here at Hudson, Arthur Herman, is involved in quantum computing, and we're at an early stage of starting to set standards for that. He was at - with a couple of private sector representatives in Switzerland recently for some standards meeting related to quantum technologies, and there were dozens and dozens and dozens of Chinese representing both government agencies and companies, and they all voted in unison. And there were, like, three Americans...

NEUFFER: Remarkable.

DUESTERBERG: ...In the room. Is that - how widespread is that? I mean, have you seen it in other technologies?

NEUFFER: I'm not close enough to it, but I will guarantee you whatever technologies have been identified as priorities, there's - and there's global standards-setting going on in those technologies, there's very heavy Chinese participation. You can be sure of that.

ARMSTRONG: And, you know, you want Chinese participation.

NEUFFER: Exactly.

ARMSTRONG: It's supposed to be a meritocracy, and it's supposed - and it benefits from all these companies who do this R&D to contribute. What it doesn't benefit from is if it's swamped or if there's a block voting or if there's a thumb on the scale, and I think that's some of the - those are the issues that we have to make sure that we have some good governance in these standards meetings. And in 3GPP - I'm not sure about the quantum standards. 3GPP, which does the 5G standards - technical standards - those eventually will come to a vote if you can't reach consensus. But in the standards-setting process for a lot of these standards, it's a consensus-building issue, which is one reason that this issue with the unintended consequences of having the technical discussions with an entity-listed company in the room is top of mind for companies like Qualcomm, because that's affecting us right now increasingly, in terms of chilling U.S. companies from participating in these standards. And if U.S. companies don't participate in these standards anymore or even scale back their contributions, then, you

know, countries who are not - and companies who are not subject to U.S. export control are well poised, like Huawei, to take the lead.

NEUFFER: Yeah. And I think one of the points that I was trying to make is that the - Huawei is, you know, indisputably a big player in 5G, and it's just absolutely important to have Huawei active in the global standards-setting bodies, and active in a way that we can have meaningful interaction with this major player. And that's where overly broad export control can limit that. And that's why we're asking the government for a clarification - an advisory opinion on that to help us sort through how to interact and still stay within the confines of the law.

DUESTERBERG: OK. Jeremie, you raised the question of trade policy, saying the United States should be more active in using trade tools to fight back against some of the practices we've been talking about in standards-making. And there is a section of the WTO technical barriers to trade which calls for nondiscrimination treatment of foreign firms the same as domestic firms. The Chinese are trying to stand up a new standards organization, the Asian Standards Development Organization, or something like that. I don't know whether it's that. But my question is, has the U.S. brought any cases in the WTO? And if they have, do we have any help from our allies in pursuing those cases? Is the WTO an effective path for adjudicating some of these issues?

WATERMAN: Yeah. So - yeah. Just to clarify, my comments were specifically about this - you know, the importance of addressing additional issues in the context of the bilateral negotiations. The - we have the phase one deal now, which we're getting more details on, and then moving on to phase two, which has more of these kinds of issues that we're talking about - the standards-setting issues, how antitrust policy is used, how other types of regulatory tools are used that can undermine a level playing field. In terms of the WTO - and actually, John is probably better equipped. He may be better equipped to speak to the issue of TBT having been more active in this space when he was at USTR. But I'm not aware - I don't know that there have been TBT cases in the - I don't know that there have been. I know certainly that industry has been very active over many years in pressing the Chinese to notify new standards to the TBT and to provide notice of - you know, requisite notice and comment periods to - again, you know, it has been a challenge.

China is now so prolific with standards. I mean, there are hundreds upon hundreds, for example, just of TC260 standards, all of - or many of which read upon trade and should be notified. It's not clear to me that they're all being notified. And then the question is, you know - and I should add, of course, the WTO does have a potential out. This is the national security exemption of the WTO, and many of these standards are coming under the, you know, banner of the cybersecurity law - right? - where there could - where I don't think China has ever taken a national security exemption, but that is a challenge. You know, I think we all know there have been issues with regard to the ability of, you know, the WTO to mete out deterrent remedies - right? - as well as the time frame for dispute settlement - right? - and all those issues. Obviously, companies that may be involved in working with the U.S. government also have to endure retaliation - right? - which has long been an issue. So there are a variety of challenges. I mean, we continue to strongly support the WTO, but it's not clear that the WTO is the best avenue for addressing these kinds of issues that we're talking about today.

DUESTERBERG: Finally, Harold, as an economist, I wanted to get your opinion on this. There have been lots of studies which claim that 5G will enable, you know, $20 trillion worth of value-

added growth in the years coming ahead. And also, a subassertion was that in - whoever is the first mover who is able to get their technologies adopted as global standards will be able to dominate other fields for applications derived from the new technologies. And they use the example of 4G, where the U.S. clearly was the leader, and we also became the leader in derivative technology - or not really derivative, but applications that took advantage of the increased speeds and latency and the like - the FANGS, for instance - Uber, Lyft, others. Is that an accurate way to think about this? Was it true for 4G that U.S. leadership and some of these other Internet technologies really was affected by dominance in the 4G standards?

FURCHTGOTT-ROTH: I don't think it's - I don't think it's quite as simple as that. Certainly, the vast majority of the value added - the vast majority of the market value on the Internet is not the hardware side. It's not on the network side. I'm sure our friends at Qualcomm wish it were, but it's...

: (LAUGHTER)

FURCHTGOTT-ROTH: It really is much more on the applications side. And the U.S. has been dominant on the applications side, I think for reasons that go beyond just where American companies were in developing the 4G standard. And - so I'm not sure of the linkage there. Are - but I think the broader question you're asking, really, is are there first-mover advantages? And there probably are some. I think the concerns I'd have are, frankly, in part, once you have a certain technology base in a company or in a country, that is not necessarily very mobile in a lot of ways. And right now we're seeing, for example, a lot of the manufacturing capacity of the world is in China, and if not in China, then certainly in East Asia. The United States is - in many types of manufacturing is no longer an active manufacturing company - country. And...

DUESTERBERG: So your point is it's hard to regain that once it's lost?

FURCHTGOTT-ROTH: It's hard to regain it, and there may be national security implications that go along with that.

DUESTERBERG: OK. Well, let's get some questions from the audience - touch on national security. And it's a tough issue. How do you draw the line between national security or other concerns and the need for participation in standards organizations? What kind of standards are acceptable? So the question is, what are the circumstances in which the U.S. government should forcefully intervene - and in parentheses, by regulation or law - with standards-setting - national security, public safety, children's safety, law enforcement or U.S. economic growth potential? So what are the valid reasons for invoking, you know, active government intervention in standards-making?

WATERMAN: Are we talking about in the domestic market or in the context of...

DUESTERBERG: Well, clearly...

WATERMAN: ...Voluntary standard - you know - standards-setting development in an international standards...

DUESTERBERG: So what are the valid reasons for invoking export controls in emerging technologies?

WATERMAN: Well, that's a different question from standards-setting. I mean, there's an export control issue about what technology is being shared, and then there's a question about, in the

context of a standards-setting, where a company like Qualcomm is working with other partners to develop a voluntary consensus-based standard, should Qualcomm be prohibited from dealing with other parties that may, for example, in the case of Huawei, be on an entity list? And I think you've heard, at least from three of us up here, that we think that's not - that's a counterproductive approach. The broader question about where do you draw the line on export controls is probably beyond the scope of this program (laughter).

ARMSTRONG: Can I...

DUESTERBERG: Yep. Go for it.

ARMSTRONG: ...Get in there? You know, if you look at the 5G and 3GPP standards - all those areas you mentioned - very important areas - children's safety, et cetera - it's very hard to draw a line between, you know, some of the technical contributions made by U.S. companies or Chinese companies in that level of technology. But - so the Uighur bill, for example, is out there for comments.

NEUFFER: Let folks know what that is a little bit.

ARMSTRONG: It's a bill - I'm sorry. This is an engineer telling you about a bill in Congress.

WATERMAN: (Laughter).

ARMSTRONG: So bear with me or correct me. It's a bill out of - a proposed piece of legislation to - out of Congress to codify, if you will, the companies on the Entity List that were put there because of the human rights violations for the Uighurs. And if you look at - did I do OK?

WATERMAN: Yeah.

ARMSTRONG: (Laughter) If you look at the text of the bill and the technologies that they're trying to regulate, if - they are - some of those technologies are very broad-use technology, where a broad reading of the bill could actually capture every cellphone in the market - for example, position location or facial recognition, image recognition. And so I think that's one of the unintended consequences. And also, those technologies are used for very proactive and very positive actions as well - for surveillance, for terrorism, et cetera. So I think - getting back to the topic of this conversation, the unintended consequences of some of these well-meaning - we all support human rights and national security, but the unintended consequences of some of these well-meaning pieces of legislation or moves by the government really are troubling. And I think these things have to be looked at very, very carefully.

DUESTERBERG: OK. We have a couple of questions that basically go to the larger question of, what is the United States government not doing well enough to be supportive of the private sector-led standards-making operations? What - I think Rob Strayer even touched on this. There is apparently a strategy in place, but is it widely shared throughout the government? Harold mentioned differences in between agencies on some of the sub-questions. Anyone who would want to comment - sort of generally?

NEUFFER: Let me just give a very foundational response...

DUESTERBERG: OK.

NEUFFER: ...Because when you get into the detailed standards world, I'm beyond my scope. But as Susie was suggesting, you know, to have strong standards development, you have to have strong R&D to plow into that. And I don't know if you've noticed, but the U.S. government, it's basic science R&D has been going like this as some of our competitors' have been going like this around the world. And in the semiconductor sector, that's quite true as well. You know, we - like I said, we contribute about 20% of our sales back into R&D - about $40 billion a year. The U.S. government R&D in our general sector, basic pre-competitive R&D, is about $1 1/2 billion a year. So the scale is completely different. And, you know, we're not - like I said, we're not asking for handouts. But the U.S. government has a key role in facilitating very basic R&D in ways that it's difficult for companies to do because companies are competing against each other. And sometimes they just can't collaborate at - on R&D. So at the very basic precompetitive R&D, U.S. government should be doing more, and that would actually help drive our standards setting - standards development ability.

DUESTERBERG: Some common and that. The National Science Foundation, for instance, if you look at the trends over the last really 30 or 40 years, it's been a steady increase in the amount of NSF funds going to the health care sciences as opposed to the physical sciences and engineering. Should we rebalance that ratio more in favor of the physical sciences and engineering and technology-related stuff?

NEUFFER: Just more money for physical sciences. But also there's a workforce side of this. You know, we've got to have smart engineers sitting in these standards-setting bodies. And if you look at STEM education, it's not enough federal support for STEM. And our immigration policies are - ought to be generous. We do a great job of educating talent from around the world, and we also do a great job of chasing that talent away once they get this fantastic education in the U.S. So, you know, that is a problem for us. You know, if we're going to develop global leading - if we're going to lead the standards development around the world, we've got to have smart people in those rooms.

DUESTERBERG: OK. Jeremie, did you want to comment on sort of the government coordination?

WATERMAN: The only comment I'd add - I think, to some degree, what is missing is a sort of 360-degree view that sort of brings all of these streams together. I think there are - you know, we want to continue to find ways to sell to China, to invest into China. We want to continue to grow the relationship in a mutually-beneficial manner. But there are questions about where the relationship is headed. And putting aside U.S. government policy for a minute, I mean, I think we've seen a series of initiatives over many years in China, going back even prior to indigenous innovation, that raised questions about, you know - and it's not just for us. I think we've heard it from Europeans. We've heard it from Japanese. I think the position papers of the foreign Chambers of Commerce in Beijing have all been fairly clear about concerns about market access and the ability to compete long-term in the market. I mean, it was I think Jeff Immelt, the CEO of GE, back in 2010, who raised the question off-mic, which then appeared in the press, about - you know, what sort of - what is our future here, and can we win? And so I think as a - based on where that dynamic is headed and the lack of, you know, R&D - basic R&D that John was just alluding to and perhaps inadequate focus on STEM education and some of these other things, we're not - you know, how do our companies maintain scale and competitiveness in the world that is - in a world that's changing? And the threads have not been connected, and we are perhaps not having the sober conversation that we need to have that will lead us, perhaps, to

the kinds of concrete policy recommendations that can help us, I think, achieve what we want to achieve.

DUESTERBERG: OK. We're close to the time we promised everyone that we would adjourn, but I want to ask the panelists if there's anything - any point they would like to make very briefly that hasn't come up before prior to this in terms of the questions or the other comments. Any last minute comments you would like the audience to hear?

ARMSTRONG: So I just think, you know, having been in the technology business for more years than I want to admit, I just see an alarming trend - and I'm very supportive of the government and national security and these policies, but I see an alarming trend of the U.S. government looking at blocking - at blocking Huawei or blocking China or blocking - or export control to block certain technologies from going. And I think I - as Jeremie and a number of people have alluded to or talked about, we - U.S. companies really need policies to help us continue to run and innovate faster. That's how we have stayed ahead in the past. It's not a foregone conclusion that we can win that way, but it's a level playing field then. You know, Chinese companies are very competent. There's very competent technology companies around the world. But if you have policies that give us access to global markets and don't do some of this - these blocking maneuvers, then U.S. companies have a chance to continue that sort of innovation that the U.S. is really known for. And I think somebody out here mentioned earlier virtual networks. These are the kinds of policies or technologies, if you will, that the U.S. government could get behind and kind of stimulate that market to grow a whole new, you know, U.S. or Western-based infrastructure market.

DUESTERBERG: John?

NEUFFER: So - totally agree. We absolutely need to put a focus on defensive efforts to protect our interests, but our success - I'll tell you in the semiconductor industry - is absolutely defined by the affirmative agenda, our ability to pedal faster. The other thing that we didn't talk about much here but it was kind of an undertow of the discussion was this concept of decoupling, and decoupling - balkanization of standards, separation of our economy from the Chinese economy. I just think that's - representing the semiconductor industry - absolutely unsustainable. It's silly, from my perspective. If we're really talking about that, we're talking about diminished national economies. We're talking about diminished lifestyles. Is that really a direction we want to go? I don't think it's a foregone conclusion that's the direction we're going to go, but I know that in both capitals - in Beijing and Washington - there are some that believe that's going to happen and that should happen. And we absolutely think that's not the case.

DUESTERBERG: Harold, anything from...

FURCHTGOTT-ROTH: Two points - first of all, on the government coordination, I think there's a lot that just could be done without congressional action - in the White House and the executive office of the president to better coordinate, for example, the export control issue. I really think this is something that doesn't need congressional action. It could be handled just by the administration itself. John, I wish I were sanguine about you with - as you - about the future of the internet, but I see balkanization - not on the equipment side, not on the network side, but on the operational internet side. It's already there, I'm afraid.

DUESTERBERG: Jeremie, last word?

WATERMAN: I agree with - very much agree with John. The only thing I would add to, I think, what John said about decoupling is typically when you talk about a major policy change - dramatic change, a rupture in this case when you talk about decoupling, - there is a - there's some analysis that goes along with that. So there is an accurate understanding among policymakers, among the public, of what the real costs are. What are the costs of decoupling? Not - for both the United States and China, we at the Chamber have attempted some - we've undertaken some of this research as - going back to 2016. Actually, we have a study that looked at China, and then we had another study earlier this year that looked at the costs of tariffs. And then we'll be - we're going to be undertaking - we are in the process of actually conducting additional research. But it is striking, I think, that there is all of this talk of decoupling without - in the absence of any real analytical work about what it means, what it will cost, what it means for consumers, for workers, for the economy, for business.

NEUFFER: For our ability to do R&D. All of it.

WATERMAN: Yeah, everything across the board, across the board. So we don't have - we're just kind of - I mean, decoupling. Wow, that sounds good. I mean, that's not the way we should be making - and it's not the way they should be making policy in China either.

DUESTERBERG: OK. Well, it's been a robust discussion. Please join me in thanking our panelists for some thoughtful...

(APPLAUSE)