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**THE ROLE OF MANUFACTURING HUBS IN A
21ST CENTURY INNOVATION ECONOMY**

HEARING

BEFORE THE

**COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE**

ONE HUNDRED THIRTEENTH CONGRESS

FIRST SESSION

NOVEMBER 13, 2013

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ONE HUNDRED THIRTEENTH CONGRESS

FIRST SESSION

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THE ROLE OF MANUFACTURING HUBS IN A 21ST CENTURY INNOVATION ECONOMY

WEDNESDAY, NOVEMBER 13, 2013

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Committee met, pursuant to notice, at 2:30 p.m. in room SR-253, Russell Senate Office Building, Hon. John D. Rockefeller IV, Chairman of the Committee, presiding.

OPENING STATEMENT OF HON. JOHN D. ROCKEFELLER IV, U.S. SENATOR FROM WEST VIRGINIA

The CHAIRMAN. I am going to give my opening statement. Then Senator Thune will get here and he will give his. And then Sherrod Brown is going to speak and then your cosponsor on our committee, Roy Blunt, will speak, and then we will go to the Secretary of Commerce, Penny Pritzker. And this is going to be a wonderful hearing.

Today the Committee seeks a solution to our Nation's economic drift away from our commitment to manufacturing. This drift threatens our long-term growth, our position at the forefront of global technology, innovation, and our national security.

Just last week we held what, I thought, was a very good hearing about how investments in basic research and development really are the core of American ingenuity. If we are going to continue to lead and compete in the global economy, we have to protect our lead in science and research, but the flow of Federal funding just does not seem to be very certain these days.

That is why we have hearings in this committee. When things are going awry—in this case, I would finger the sequester—we have hearings and we bring it out. And if people who are elected respond, that is good, but at least the audience will have a chance to.

So we are worried about the path that this country is on, and we desperately want to help. Today's hearing builds on the last conversation we had at the last hearing. Just as R&D will lead to new scientific discoveries and product innovations, these investments are crucial for the long-term growth of the manufacturing sector, a favorite subject of the Senator from Ohio.

Innovation and manufacturing have long come together to form the backbone of the American economy. Great ideas conceived by American scientific minds were molded and built by American hands. The steel we milled, the automobiles and planes that we produced, and the computers that we made won us world wars,

spurred our economy, and secured the livelihoods of a great middle class.

But, unfortunately, success stories are becoming all too rare. In the last decade, we have wasted promising scientific research and have failed to translate technological success into manufacturing growth and jobs. Factories have vanished across our country. It is a terrible sight. If you come from a Rust Belt-type State and factories vanish, they vanish but the superstructure doesn't. If you have been to Bethlehem, Pennsylvania, they have got about 5 miles of rusted-out ex-Bethlehem Steel Corporation buildings. Now, that has all been turned into modern shopping malls and all the rest of it.

But I remember my sister and I went up, as we do every year, for the Bach Festival, and it was just a stunningly sad sight. Miles of rusted, empty factories and something called steel. And when these factories are gone, we have lost the jobs, and then we lose the know-how and the infrastructure that feed the manufacturing sector and many, many of our local communities.

The list of products we have already lost is too long to recite. Laptop computers, flat panel displays, lithium-ion batteries, solar cells, and semiconductors are all examples of products that were invented here but are now produced overseas. They all have driven and will continue to drive the global economy, but the skilled workers and the infrastructure and the knowledge to manufacture them are no longer based in the United States.

Meanwhile, foreign countries are taking the technology innovations created by American hands and American brains and using them to their economic advantage. I cannot blame them for that, but we are allowing that to happen. And these countries are investing in even greater support for their manufacturers to help them bring new, better, and cutting-edge products to the market.

The United States must do the same. It must continue to invest in programs that help keep production in the United States and commercialize technology wherever they are conceived. Experts say a key problem for U.S. manufacturing is the so-called "valley of death," the gap between invention and commercialization that dooms so many manufacturers today. It is vital that we bridge this gap; that is, we must help transform the brilliant scientific discoveries taking place in university laboratories, many places, into real world applications on the factory floor.

Today we will be hearing about proposals that seek to bridge that very gap and by folks who are doing it. The proposals would establish a public-private network of manufacturing hubs, each dedicated to a particular technology that holds promise to help Americans stay ahead of our global competitors. In short, these hubs would help our economy by lending a hand where the free market just does not work well—the risky and uncertain period that stands in the way between great inventions and great commercial products. These hubs would leverage our scientific research and close the valley of death if we follow through as is being tried in Youngstown, Ohio.

Already the pilot institute in Youngstown, Ohio has shown the economic promise of this proposal. That institute has brought together the private sector, the public sector, and academia to solve

common problems in additive manufacturing, also known as 3D printing, which absolutely blows my mind. It is the most amazing thing I have ever heard of. I am still not prepared to believe it is true.

[Laughter.]

The CHAIRMAN. But I am going to by the end of this hearing.

This institute is bringing us closer to the day when household products, industrial parts, artificial limbs, and even human tissue can easily and cheaply be created from scratch from a digital code that involves no assembly or parts.

The implications of this technology are enormous and, because of the pilot institute, may soon play a role in strengthening our manufacturing sector and the rest of the Nation's economy.

I very much look forward to hearing from the witnesses today on this initiative and their ideas to strengthen U.S. manufacturing, and I thank them for appearing before this committee. And I have always particularly thanked the Ranking Member, John Thune. And we did a good job yesterday. Did we not?

**STATEMENT OF HON. JOHN THUNE,
U.S. SENATOR FROM SOUTH DAKOTA**

Senator THUNE. We did. Thank you, Mr. Chairman. Yes, good work on your part.

Did you want these guys to go before me, or do you want me to make my opening statement?

The CHAIRMAN. I want you to speak.

Senator THUNE. All right, very good. I will do that.

I also want to send my welcome to the new Senator from New Jersey to the Committee, Senator Booker.

Mr. Chairman, I thank you for holding this hearing on efforts to promote U.S. manufacturing and advance our innovation economy. There is no question that manufacturing is critical to our Nation's economy and our global competitiveness. We see evidence of this in each of our States.

In my home state of South Dakota, more than 1,000 manufacturing firms support more than 41,000 jobs, or roughly 10 percent of the state's workforce. Manufacturing comprises 9.4 percent of South Dakota's economy, contributing \$4 billion to our state's GDP. And in 2012, as reported by the Governor's Office of Economic Development, South Dakota had the fifth largest increase in manufacturing among the 50 states.

I would add that South Dakota is a great partner when it comes to providing low cost of doing business. In fact, CNBC ranks South Dakota as the top state for business in 2013. This is attributable not only to the low tax burden—no individual or state income taxes and low sales and property taxes—but also to the low utility rates and favorable legal and regulatory climate.

South Dakota, like most of our states, also participates in programs managed by the Department of Commerce to promote domestic manufacturing. For example, in January of this year, the Manufacturing Extension Partnership, or MEP, run by the Commerce Department's National Institute of Standards and Technology awarded cooperative agreements of \$400,000 to South Dakota Manufacturing and Technology Solutions to support the first

MEP center in the state in 10 years. The new center is based at the University of South Dakota in Vermillion and is part of a Small Business Development Center network.

So I appreciate that the Federal Government has a role to play in promoting U.S. manufacturing. Today we will begin an examination of what that role should be with a particular focus on the Administration's proposal to create a network of manufacturing hubs, a proposal that is largely embraced in legislation introduced by Senators Brown and Blunt.

I welcome Senator Brown to the Committee today. I look forward to hearing from him and our colleague on the Committee, Senator Blunt, about their legislation, which enjoys the support of groups like the National Association of Manufacturers and Semiconductor Equipment and Materials International (SEMI).

I also want to welcome Secretary Pritzker back to the Committee for her first appearance since being confirmed, and I look forward to the perspective of our impressive panel of industry witnesses, several of whom are experienced at turning cutting-edge research into commercial products.

I hope that as we examine the issue of how best to ensure U.S. leadership in advanced manufacturing, we will do so with an eye toward maximizing value for the taxpayers and avoiding duplication with the host of existing Government programs.

Also, while perhaps outside the scope of this committee's jurisdiction, if we admit any limits to our jurisdiction, we should acknowledge that there are several policies that may hold even greater promise for incentivizing innovation and manufacturing. These include eliminating barriers to free trade, enacting meaningful tax reform, including the competitive territorial tax system that will strengthen the ability of U.S. companies to compete with global competitors, not to mention the long overdue need to reinstate Trade Promotion Authority that until recently has not been a priority of the current Administration.

We also cannot ignore the importance of regulatory reform when it comes to our competitiveness in manufacturing. Just 2 weeks ago, the National Association of Manufacturers announced that our former colleagues, Blanche Lincoln and George Allen, will co-chair the Manufacturing Competitiveness Initiative, an effort aimed at examining and highlighting the competitiveness challenges facing manufacturers. Among the first issues this bipartisan initiative will address is the impact of unnecessarily burdensome regulations on U.S. manufacturers.

With that said, Mr. Chairman, I thank you again for calling today's hearing and I thank the witnesses for their testimony. I see we already have Mr. Blunt here, our colleague from the Committee, Mr. Chairman, to join Senator Brown and look forward to both of their statements.

The CHAIRMAN. Thank you, Senator Thune.

Well, Sherrod Brown is not on the Committee. Can we actually let him speak?

[Laughter.]

Senator THUNE. You can give him special dispensation, Mr. Chairman.

[Laughter.]

The CHAIRMAN. All right. Special dispensation to the distinguished Senator from Ohio, provided that equally special dispensation, totally unneeded, go to Senator Blunt. And Secretary Pritzker, we apologize but these two folks really care about manufacturing. OK?

Senator Brown?

**STATEMENT OF HON. SHERROD BROWN,
U.S. SENATOR FROM OHIO**

Senator BROWN. Thank you, Mr. Chairman. It is a pleasure to be in front of your committee again. And thank you for your leadership. Senator Thune, thank you. And, Senator Booker, congratulations on your first hearing. Senator Fischer, thank you.

West Virginia and Ohio share a border, and citizens of one State often work in manufacturing in the other. Citizens in Ironton work in Huntington. People in Parkersburg work in Marietta. I have always been proud to stand shoulder to shoulder with Senator Rockefeller in defending our glass and steel manufacturers against unfair trade practices. I appreciate the Commerce Department and the ITC and what it has done to enforce trade rules. I look forward to promoting new technologies that are the subject of this hearing.

I would like to acknowledge Senator Blunt who is as strong an advocate for American manufacturing as there is in this Senate. I am proud to partner with him in writing legislation that the Committee is considering today. I particularly appreciate the Commerce Committee staff, majority and minority, for stepping up on this hearing and putting this together as quickly as you could under Senator Rockefeller's leadership.

Senator Blunt and I spoke on the Senate floor a few days ago about the kind of bipartisan effort we have in manufacturing. He asked the right question. How can we have a strong economy if we do not produce, if we do not make things? In Ohio and Missouri and I think in New Jersey and Nebraska and South Dakota and West Virginia, we understand that manufacturing is a key to the middle class. That is why I am pleased today to be followed by Secretary Pritzker, by Mike Garvey who is the CEO of M-7 Technologies in Youngstown, Ohio, and by Eric Spiegel who is the North American CEO of Siemens, also a Youngstown, Ohio native, if you catch the thread going through this conversation, Senator Rockefeller.

[Laughter.]

Senator BROWN. But that is not the end of my statement.

The CHAIRMAN. Your subtlety has come through.

Senator BROWN. Washington has made choices, I believe, that have left manufacturing behind, whether it is a bias towards finance at the expense of manufacturing, whether it is trade deals or not enforcing trade laws or unfair taxes or a failure to focus on innovation and technology. As a result, we have seen communities like St. Louis and Cleveland and Kansas City and Lordstown and Beckley and Charleston—all over our states—live with the consequences, between 2000 and 2010, of 60,000 plant closures and 5 million lost manufacturing jobs. This devastates manufacturing communities. You know what happens to a city of 30,000 or 40,000 or 50,000. Our states, particularly Missouri, Ohio, and West Vir-

ginia, have a number of cities, 30,000, 40,000, 50,000, where when one or two plants close, the devastation of those communities, particularly when a husband and wife work at the same plant—we know the damage it does.

The Commerce Department tells us every dollar in final sales of manufacturing products supports \$1.48 in output from other sectors. That money is taken out of an economy when a plant closes, taken out of a community, put into a community when a plant hires more people. It is the largest economic multiplier of any sector.

We have seen an up-tick in manufacturing job growth for the first time since the 1990s. But for too long we have been suffering from the syndrome of innovate here, invent it here, develop it here, but make it elsewhere. Now, more than ever, we need to do more to retain and attract new manufacturing jobs, which is what Senator Blunt's and my legislation is all about.

A few years ago, I toured the largest yoghurt manufacturer in North America. It is a plant in Minster, Ohio near Neil Armstrong's home of Wapakoneta north of Dayton. Several hundred worked there until only a few months before I visited. The supplier would sell plastic cups to the plant. They had these large silver vats that they would squirt the fermented milk, the yoghurt, into these little plastic containers. A young industrial engineer and two people that had worked on the line for a decade or so figured they could be more efficient and find a much better way. The line was about 50 feet. They took a roll of plastic. They fed the sheet of plastic on the line, heated it, extruded it, then slowly cooled it, and squirted the yoghurt.

The point of that story is not that an engineer could figure things out like that. The point of the story is the innovation so often takes place on the shop floor, and when we innovate and then make it elsewhere, we lose the edge we have. We lose the innovation both on the process of manufacturing and on the product that is manufactured. That is fundamentally the importance of what Senator Blunt and I are trying to do to help these companies find ways to do this manufacturing in this country.

Along the Ohio Turnpike from Toledo, through Lorain south of Cleveland, Akron, Youngstown is really in many ways the auto belt in this country. Glass coming out of Toledo. Steel in Cleveland. Rubber tires in Akron. Assembly in Youngstown. The point of thinking of these manufacturing hubs is sort of like teaching hospitals where the innovation and the research is taking place, and the kind of job spin-offs and commercial activities happen nearby. It is what has happened in Toledo and Akron. Toledo, once a glass center, has become one of the top two or three cities in the country in solar production. Akron, the tire center of the universe at one point, certainly of our country and of the world, has become a leader in polymers in large part because of what they have learned.

What we are doing in Ohio to expand our skills is beginning to catch the Nation's attention. President Obama tomorrow is going to Arcelor Mittal, a steel plant in Cleveland, the first place ever that steel has been produced where a 1 person-hour has been able to produce 1 ton of steel. Workers in this plant are now making advanced high strength steel used in the auto industry, used for ap-

pliances. Great news for the nearly 800,000 jobs in Ohio tied to auto manufacturing.

Our proposal and network for manufacturing innovation would expand upon recent successes to create these kind of public and private partnerships focused on bridging the commercialization gap for technologies identified by industry. These regional industry-led institutes will leverage local expertise and provide stable, high wage employment for millions of next generation workers.

In August, the first ever—and Chairman Rockefeller mentioned this—National Additive Manufacturing Innovation Institute opened in Youngstown. The institute is driven by a tech belt corridor crossing Ohio, the northern panhandle of West Virginia, and Pennsylvania, supported by \$30 million of Federal funding, matched by \$40 million of private funding aimed to accelerate the 3D printing commercialization. The Youngstown center directly addresses the “innovate here, make it there” syndrome by tying together manufacturing supply chains with product development. Nations that we compete with have made tremendous efforts to develop the exact type of public-private approach embodied in Youngstown and embodied in our legislation.

In 2002, the U.S. trade deficit in advanced technology products was over \$91 billion. This balance has not been positive since 2001. It is time we seize this opportunity. That is why our common sense bipartisan legislation has been endorsed by the National Association of Manufacturers, the Semiconductor Equipment Manufacturers, the Information Technology and Innovation Foundation, the AFL-CIO, and lots of other groups. We are at a moment of great opportunity for manufacturing. This legislation and the interest of this committee can help us get there.

And I particularly again thank Senator Blunt for his work.

The CHAIRMAN. Thank you, Senator Brown.

Senator Blunt?

**STATEMENT OF HON. ROY BLUNT,
U.S. SENATOR FROM MISSOURI**

Senator BLUNT. Thank you, Chairman.

And I am glad to be working on this with Senator Brown. He and I were secretaries of state together, and I have actually worked with Senator Brown longer than anybody else in the Senate because of that relationship that goes back a number of years.

I would also like to be able to speak second because Senator Brown does such an expansive job of explaining what we are trying to do here.

The CHAIRMAN. This is the shortest I have ever heard.

[Laughter.]

Senator BLUNT. Well, me too. It was the shortest I had ever heard Senator Brown speak as well.

We were on the floor the other day talking about the importance of a country that focuses on making things again and how many policies have to come together for that to happen. I think when you look at the overall picture of the economy, we are really at a breakthrough moment where, my belief is, a decade from now, we are going to look back in a lot of areas and think how could we have made this much progress this quickly as we figure out how to do

a better job of putting things together, of taking advantage of the opportunities that we have in front of us.

The idea that this bill really focuses on is manufacturing hubs for high-value manufacturing industries like aerospace technology, biotech, pharmaceutical technology, automotive, semiconductor equipment. All of that could fit into that view of what we think can happen here. And it is really just bringing more of our tools together and creating a way that that can happen.

A lot of the countries we compete with are really focused on state-sponsored entities. So it is very easy for them to put all this together and very easy for them to do whatever they need to rule-making-wise, regulation-making-wise, whatever else they need to do to be sure they are out there cutting through all the red tape and getting through the obstacles.

We think this bill does that by using the public-private partnership model. You know, even at the Youngstown effort that Senator Brown was talking about, the University of Missouri is one of the places that is involved with them in talking about how to use engineering and other things that we have some unique perspectives on in our state. But we are excited about making things in Ohio as well and West Virginia and a country that makes things again.

We are beginning to see a return to manufacturing. We have seen at least a 10-year decline in manufacturing and beginning to see those numbers head the other way. The opportunities for our workers to compete, for our workers to use the kind of technology, even in yoghurt making that Senator Brown was talking about, to where you may not be adding any new jobs when you do that, but you are securing every single job you have got and producing more in that facility in a more competitive, more effective way, and you are saving those jobs that we all know are so important to families. When a business goes out of business and those families lose that income, it makes a big difference.

So we are looking here for things that ensure that the limited resources that the Government has really pack the greatest punch. To develop the workforce of the future, we can combine efforts to reach out early to students, bring together industry, small business, large companies, academic institutions in a way that I believe we both think meets today's demands better than some of the existing programs. I think a lot of our programs, while well-intentioned and effective at one time, do not quite grasp how many things can come together now to make us more competitive and create more opportunities.

And so, again, I am pleased to be working with Senator Brown on this. I am grateful to the Committee for holding this hearing, and I am particularly pleased that Secretary Pritzker and the witnesses, the two panels we have today, are here to talk about what they think this legislation could do.

The CHAIRMAN. Thank you, Senator Blunt. And thank you both because you have introduced something which is very close to you and which is sometimes overlooked in the swirl of world events and political crises and all the rest of it. Thank you both a lot.

We have actually today two panels. The entirety of the first panel is Secretary Penny Pritzker, who has vast experience in what we have been talking about and is very enthusiastic about it. And

so, Secretary Pritzker, we welcome you. As was pointed out, this is your first appearance here. It was hard enough to get you confirmed. But you are here and that is all that matters. And you are raring to go and you are a can-do person. I have known you a long time and you are terrific. So please proceed.

**STATEMENT OF HON. PENNY PRITZKER, SECRETARY,
U.S. DEPARTMENT OF COMMERCE**

Secretary PRITZKER. Well, thank you, Chairman Rockefeller, Ranking Member Thune, and members of the Committee. I really appreciate your calling this very important hearing. This is a subject near and dear to my heart. So I welcome the opportunity to draw attention to the need for the National Network for Manufacturing Innovation. And the Administration is pleased to support bipartisan legislation introduced by Senators Sherrod Brown and Roy Blunt.

So let me begin with a brief anecdote. In the 1980s, you may recall that we were at risk of losing our competitiveness in the semiconductor industry. To ensure that did not happen, the U.S. Government made a major investment and partnered with a dozen chip companies.

On one of my first trips as Secretary, I went to Albany, New York where you can see how that collaboration is now bearing fruit. There, would-be rivals are jointly engaging in what we call pre-competitive research. Along with a local college, they have fostered a global hub of innovation where scientific breakthroughs are leading to better American products and stronger U.S. competitiveness. As a result, that region is now attracting billions of dollars in global business investment and thousands more jobs. I am convinced that we can replicate that model of success through the NNMI.

With 27 years of business experience, I came to the Commerce Department with the belief that our efforts should largely be driven by industry needs. NNMI is not a Government idea. It comes from a group of 12 top CEOs and six top university presidents, along with input from about 1,700 of their peers. They saw that the private sector was not filling key gaps. The path from R&D to market had eroded. Production processes were outdated, and workers were not ready for the next generation of high tech and advanced manufacturing jobs. They looked to places like Albany and saw that we could bring together companies, universities, community colleges, and local governments to address these problems by co-investing in institutes that unleashed the full potential of burgeoning local industrial ecosystems.

They also saw that other countries, particularly in Asia and in Europe, were making major investments like this, putting us at risk of losing our competitive edge. None of us here today wants that to happen.

The good news is that the Federal Government can provide relatively modest seed funding that will both attract co-investment and catalyze the growth of these institutes. In 5 to 7 years, those hubs will be self-sustaining. You will be hearing shortly from business leaders who know that this is a strategically sound approach.

The NNMI will help American manufacturing leapfrog into the 21st century at a moment when we need it most.

And we must remember the crucial importance of manufacturing in our economy. Manufacturing accounts for 70 percent of U.S. research and development, 70 percent of patents, and the vast majority of U.S. exports. Manufacturing jobs earn 17 percent more than those in other sectors, helping our middle class stay strong. And with about a half million manufacturing jobs added over the past 6 years, we clearly have some momentum.

As you know, we already launched a Department of Defense institute focused on 3D printing, a technology that is flourishing among entrepreneurs and established companies worldwide. In the coming months, the Department of Defense and Energy are launching three more pilot institutes: one in lightweight metals, another in digital manufacturing and design, and a third in power electronics. We need to lead in these emerging fields, as well as many other fields beyond defense and energy. The Brown-Blunt legislation would allow us to move forward in a smart and comprehensive way. The NNMI is a truly game-changing approach to 21st century American manufacturing, an approach crafted by our country's own leading minds in this sector.

So I look forward to working with this committee to make the NNMI a reality, and I look forward to your questions.

[The prepared statement of Secretary Pritzker follows:]

PREPARED STATEMENT OF HON. PENNY PRITZKER, SECRETARY,
U.S. DEPARTMENT OF COMMERCE

Introduction

Chairman Rockefeller, Ranking Member Thune, and members of the Committee, thank you for calling this important hearing to examine the role of manufacturing hubs in a 21st Century innovation economy.

I welcome the opportunity to discuss a proposed National Network for Manufacturing Innovation (NNMI), and am supportive of the approach in the bipartisan legislation recently introduced by Senators Sherrod Brown and Roy Blunt on this topic.

The NNMI legislative proposal would largely implement recommendations by the first Advanced Manufacturing Partnership (AMP) Steering Committee, a task force of 12 leading company CEOs and six university presidents, with input from 1,700 members of industry and academia. Co-chaired by Dow CEO Andrew Liveris and former Massachusetts Institute of Technology (MIT) President Susan Hockfield, the AMP Steering Committee issued a report to the President in July 2012 entitled *Capturing Domestic Competitive Advantage in Advanced Manufacturing*. Among its findings was the need for a network of manufacturing innovation institutes. These institutes would allow companies to collaboratively invest in precompetitive research to tackle manufacturing challenges they cannot address individually. The institutes would provide companies, including small manufacturers, access to capital equipment and facilities to conduct testing and research in order to accelerate to the market new cutting edge technologies. A new generation of our manufacturing workforce would be trained in an environment similar to a "teaching hospital" for advanced manufacturing, where engineers, researchers, and workers are able to gain new skills and capabilities working on state-of-the-art equipment and new manufacturing challenges.

Manufacturing Innovation

It is an exciting vision that has been widely embraced. Just two weeks ago, the National Association of Manufacturers (NAM) and other organizations including Semiconductor Equipment and Materials International, publicly announced that they are supporting this effort.

Before elaborating on this vision, I would first like to discuss the commercial problems these institutes are meant to solve. As you know, I come to the Department of Commerce as a business person, particularly sensitive to market demands. Many in private industry have embraced the institute concept because they see a need for

industry leaders to collaborate on advanced technology challenges in order for the United States to secure a competitive edge. Others believe it will spark economic development in regions that have been hard-hit by previous recessions. And these private sector leaders wholeheartedly endorse the Institutes as a critical national investment to rebuild manufacturing capabilities and strengths that have eroded over the last decade as manufacturing went offshore.

In fact, since 2001, the United States has lost production across a range of advanced technology industries where the United States had previously been dominant. This phenomenon was caused largely by companies' increased reliance on global supply chains, which has allowed companies to tap specialized manufacturers from other countries to produce high-performance parts. Over the long-run, this reliance shifted production and often innovation overseas as well.

As a recent MIT study points out, innovation occurs not only at the point of invention, but at every stage of product development and delivery. This was the rationale behind the iconic Bell Labs where engineers co-located beside technicians to develop and continually improve production processes for telecommunications equipment. Or at companies like DuPont, where partnerships between design and production specialists led to an affordable manufacturing process for Kevlar in 1970—finally making the material marketable, five years after it had been invented.

On the other hand, when a company's inventors and design engineers are separated from the production process, that company may be hindered in its abilities to improve products or develop new goods and services. This separation is why scholars now suggest that certain industries created in the United States—such as flat panel displays and certain consumer electronics—have moved entirely offshore. In some of these cases, manufacturers built assembly facilities in Asia which made it attractive for parts suppliers to re-locate there as well. Soon, entire supply chains were migrating out of the United States, and we lost our ability to lead in the innovation and production of these types of products.

The NNMI will allow the United States to rebuild the dense networks of capabilities that it lost during the past two decades of manufacturing offshoring. Bringing large manufacturers, universities, and small businesses together in institutes will help restore U.S. competitiveness in manufacturing. This is critically important for boosting U.S. innovation and exports, and it will facilitate middle class job growth. Indeed, the manufacturing sector accounts for 70 percent of U.S. private-sector research and development, 70 percent of patents, and the vast majority of U.S. exports. Manufacturing jobs provide a key pathway into the middle class, with workers earning between wages and benefits 17 percent more than their counterparts in other sectors.

Catalyzing industry to strengthen American manufacturing capabilities has worked for us in the past. Twenty-seven years ago, the Reagan Administration sounded the alarm over a crisis in the semiconductor industry. We were fast losing market share and would eventually lose our entire industry if nothing was done.

For the Department of Defense this posed a national security risk. As a result, SEMATECH was born; the Pentagon invested \$500 million into a small consortium of U.S. companies, allowing industry rivals to collaborate in road-mapping the future of semiconductor chip technology and to develop the manufacturing processes necessary to mass produce those chips. Instead of each semiconductor manufacturer spending money to design its own equipment in isolation, SEMATECH provided a forum for companies to work together and develop common standards for next generation chip manufacturing technology.

Just this last July, I visited SEMATECH at its new home on the seven-year old campus of the College of Nanoscale Engineering of the State University of New York (SUNY) in Albany, New York. SEMATECH has not received Federal matching funding for over fifteen years, having evolved into a self-sufficient enterprise—and having grown to include over a hundred international players.

What I found particularly fascinating were some of the College's other partners. Unlike SEMATECH, which focuses on research into manufacturing processes, the College's other partners are helping transition additional emerging research into actual manufacturing capabilities—in the same vein that we are proposing for NNMI. One such initiative is the Global 450 Consortium—an effort to make the surface on which we make chips—called wafers—bigger. This could bring down costs and add more functions to our smartphones, tablets, and car electronics.

This consortium, started up just in the last two years, is comprised of IBM, Intel, Samsung, TSMC, and Global Foundries as well as the State of New York. Each company recognized this effort was high risk, extremely expensive, and beyond the capability of a single company. But, on this great college campus, these companies are now pooling resources and sharing risk to try to develop manufacturing equipment together. By collaborating they advance the “pre-competitive” technology that can be

inserted into final products that are more proprietary. Because this work goes on here, the innovation, company growth, and high tech jobs are here. Additionally, students at various levels on the campus will have an opportunity to train on how to use this equipment and develop new production techniques. The College itself functions as a trusted third party, not only providing the space for conducting collaborative research, but also managing complex arrangements for sharing intellectual property. The College is in effect coach, convener, and arbiter—and has developed a successful model for protecting companies' proprietary interests.

The innovations taking place at this facility are breathtaking. So much so, that semiconductor companies from around the world are investing tens of billions of dollars to build factories in that region and creating thousands of new jobs, just to be close to the College and tap the collaborative research and scholars available nearby. In fact, just this year Global Foundries—the second largest chip maker in the world—announced another \$7 billion expansion of its multi-billion dollar facility in neighboring Saratoga Springs.

Companies in this industry are flocking to the region because they believe being a part of this industrial ecosystem is critical to their long-term competitiveness; in turn they are building multi-billion dollar complexes. This case shows what can happen when the Government—whether Federal or state—provides initial seed funding, and helps convene industry and university partners to collaborate in manufacturing research and workforce training. In my view, this should be an inspiration for aspiring NNMI institutes.

The Missing Middle

What is transpiring in upstate New York can and must take place elsewhere around our country. The United States has long invested public dollars in initial or basic research, and, in many industries, companies are likely to invest in late-stage development—once a product has been proven and a market is beginning to materialize. But what about that middle stage—when a technology has been invented but there is no established process for scaling up its production?

To lead the world in advanced manufacturing means to lead not just in initial invention but all the way through production. Other countries, particularly in Asia and Europe, have been investing billions of dollars in such “technology transition” for decades, and have their own programs analogous to NNMI. It is time to find a uniquely American solution to the challenges associated with moving technology from lab to shop.

National Network for Manufacturing Innovation

A uniquely American solution must be led by the private sector. The Administration relied on the advice of 1,700 members of industry and academia who provided inputs into the AMP report. The NNMI program will eventually be wholly owned and operated by companies and universities—not the Federal Government. However, as evidenced by history, these endeavors will require seed funding to make it possible for companies, universities, community colleges, nonprofits, and others to join a manufacturing innovation consortium. Our proposal is for the Government to provide that “patient capital” for about five to seven years, and then allow an institute to operate on its own. In essence, the public investment is in the U.S. innovation ecosystem—to create the space for industry and academia to solve industry-relevant problems. In the process, the institute will need to prove that it can and will be self-sustaining long after the Government ends its investment, and that it can meet critical market demands. There is indeed a demand for this sort of program. I have seen it firsthand in Albany. But I can assure you, there is a hunger for these institutes all across the country. This is evidenced by the great interest and robust competitions for new manufacturing innovation institutes being held by the Departments of Defense and Energy right now.

As members of this committee are aware, last year, the Department of Defense led a competition to establish a pilot institute. The institute focuses on additive manufacturing and 3D printing—an area of great importance both to the Armed Forces and the broader economy. This technology is literally something out of “Star Trek”—allowing individuals to use a computer to design intricate structures and shapes traditional manufacturing processes simply could not make, and then “printing” or “beaming” them layer-by-layer into existence with unprecedented precision.

The Air Force and Navy want to use this technology to build high-performance aircraft and engine parts. The Army and Defense Logistics Agency might use this technology to have instant access to spare parts in-theater, when combat vehicles break down, or to recreate replacement parts that have been out of stock for decades. And in the commercial market, one can conceive of virtually endless applications for these tools—ranging from automotive and medical device production to

fashion and apparel. These sophisticated and expensive production machines are far from perfect—and the institute is a big part of making them better. It is also important to develop the standards for 3D printed parts, training programs, and the skilled workforce needed to support new businesses. Improvements in these production machines are spilling over to consumer markets, where inexpensive printers for schools and homes are rapidly expanding. But much remains to be done to bring the technology fully into the mainstream.

Moreover, if the United States is going to be a global leader in advanced technologies, such as 3D printing, we are going to need to bring all of our leading industry and university resources to bear. We need to recognize that the rest of the world is not sitting on the sidelines. I assure you, many other countries are investing heavily in 3D printing as well as a host of other advanced manufacturing technologies. We need to get this right to remain globally competitive.

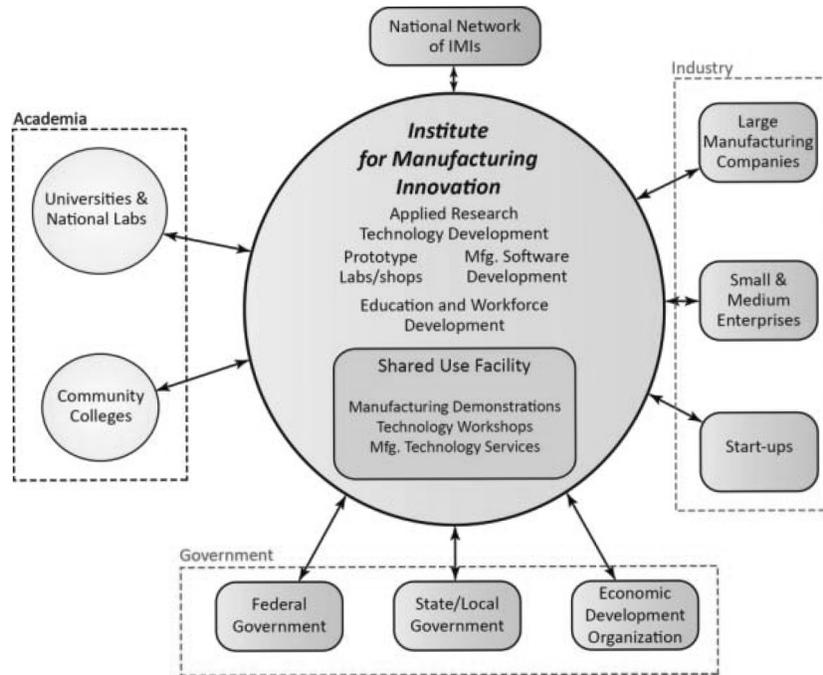
Fortunately, there is high demand in the United States to do just that.

From what I am told, competition was fierce for the pilot institute. In the end, the Government put \$30 million on the table, and the winning consortium matched this sum with an additional \$40 million. That money is going towards funding labor, equipment, and applied research projects. The pilot institute was formerly known as the National Additive Manufacturing Innovation Institute, and was recently renamed America Makes. Its headquarters is now open for business in Youngstown, Ohio. Consortium members included, among others, Northrop Grumman, Honeywell, IBM, Timken, and RTI International; university participants included Case Western, Carnegie Mellon, Penn State, and Youngstown State—as well as Marshall University in your home state, Mr. Chairman. And membership continues to grow. While many feel the future promise of this technology is certain to be astonishing, what is far from certain is where the global innovation hub for 3D printing and additive manufacturing will be located. The mission of our pilot institute is to ensure this hub is in the United States.

But what exactly happens at an institute?

The answer is: “A lot.” Industry members are crafting detailed roadmaps of their technology needs, collectively defining milestones and then developing strategies to meet those goals. Institute members are collaborating on applied research projects, developing facilities to evaluate nascent technologies and improving equipment and processes for unproven technology to be scaled up to production. By using shared facilities, manufacturers can pool their risk, and drive down the cost of commercialization. Working with university researchers and design engineers, manufacturers can accelerate the insertion of these critical technologies into mainstream manufacturing. Through this process, institute members are establishing new business networks, coordinating their actions, and redefining supply chains and business practices. In particular, institutes offer opportunities for small and medium-sized enterprises to enter these supply chains and access equipment they ordinarily would not be able to afford to use. Finally, community colleges and universities are training new generations of workers on cutting edge technology available at the institute and establishing pipelines for U.S. employers to hire skilled workers. By engaging with colleges and universities, the institutes will both incent and support educators to assure the knowledge and skills of our workforce—building additional science, technology, engineering and mathematic (STEM) career pathways for youth and adults. This aspect of the institutes will be essential to keep the manufacture of new products from moving offshore.

The institute itself provides facilities, equipment, and software for collaborative research. It also helps arrange intellectual property sharing, both to advance technology breakthroughs as well as protect members’ proprietary rights. As illustrated below, institute members can range from research universities and national laboratories to community colleges; large manufacturing companies to small and medium-sized enterprises and start-ups; and state and local governments to economic development organizations.



Ultimately, the Administration envisions a collection of these institutes forming a network. Institutes will thrive not only from collective action within their own consortia, but also through cross-pollination across industries. All parties involved in these institutes will advance competitiveness in their respective technology fields as well as more broadly support our economic and national security interests.

The pilot institute currently underway has demonstrated the great demand for these capabilities among all of these actors. Applied research projects co-financed by the Government, industry, and universities are well-underway. And the institute continues to see its membership and private investment rise. For example, in May of this year, Siemens announced a \$440 million in-kind grant to Youngstown State University to help train the next generation of 3D printing manufacturers. I am eager to see how it matures over the next several years.

Meanwhile, the Departments of Defense and Energy have launched three more competitions. The Pentagon solicited proposals for consortia focused on lightweight and modern metals as well as digital design in manufacturing. Energy's new institute will focus on enabling more powerful, efficient, and more cost effective power electronics. These are critical endeavors, and we are eagerly awaiting the announcement of competition winners. These new institutes, like the pilot, will continue to help us hone this model and, more importantly, address critical manufacturing technology needs for our country.

In sum, by developing these institutes in partnership with industry and academia, the Government will address two critical issues industry leaders say they cannot solve without assistance. First, it will incentivize companies and universities to work together in promoting innovation and production here at home. Second, it will help companies within an industry ensure that U.S. supply chains are effective and well-integrated.

Congressional Authorization

In order to enable this program to reach its full potential, Congressional action is required to authorize this program and provide the necessary funding. The "Revitalize American Manufacturing and Innovation Act of 2013," sponsored by Senators Blunt and Brown, would authorize Commerce to award funds to assist in planning, establishing, or supporting the centers for manufacturing innovation, which will constitute the network. It would also establish a National Office of the Network for

Manufacturing Innovation Program within the National Institute of Standards and Technology to oversee and carry out the program. These are both important steps in meeting the President's call for the NNMI.

Although the institutes being developed under the leadership of the Departments of Defense and Energy under existing authorities are important, at present we have no Federal program exclusively focused on identifying emerging technologies with broad potential impact and bringing together companies in associated industries to improve technology transition. Instead, we are meeting our Nation's demand by tapping existing Federal programs. By relying on these mission agencies, we are confining the institutes' topics to areas that are relevant primarily to these agencies' missions, which exclude many other topics with significant potential impact on manufacturing.

Ultimately, these institutes need to be driven from the bottom up; we need to empower U.S. industries to identify where their comparative advantage lies and where the need is greatest to collaborate in manufacturing innovation institutes. Our role should be to support those decisions, help them underwrite risk when we can, and thus help unleash the full might of the American innovation economy.

This question was posed to industry in five different public events along with a request for public comment—"What are the topics that are most important to industry, appropriate for an institute, and that industry would co-invest in?" The response was overwhelming—135 topics. Which should be established? Let consortia teams put together proposals based on market needs—not a Federal agency's requirements. Awards will be made through merit-based competition that selects the best business case to receive start-up funding and become part of the network. Additionally, we will continue to rely on the private sector, through forums such as the Advanced Manufacturing Partnership, to ensure NNMI meets industry needs and advances American competitiveness.

In Fiscal Year 2014, the President's Budget has called for \$1 billion for up to 15 institutes built over multiple years to jumpstart the vision shared by AMP, NAM, and so many other leaders across industry. This proposed multi-year funding will provide the consortia the certainty needed for members to commit to fully matching the Government contribution. As the concept has developed, so has the demand. In fact, the Administration believes the network could ultimately reach a total of 45 institutes. As a comparison, Germany has 60 *Fraunhofer* Institutes—similar in concept to NNMI—despite having an economy a fraction of the size of ours. It is critically important that we make the NNMI a reality. The approach in the Brown-Blunt bill is an important step in advancing this conversation.

I look forward to working with this committee to move this important legislation forward.

Conclusion

Today, manufacturing remains critical for both economic and national security. As I discussed at the outset, addressing the challenges facing America's manufacturing sector is absolutely essential both for our ability to employ skilled workers as well as for our ability to maintain our competitive edge in the world economy.

Innovation is America's comparative advantage. It is the lifeblood of advanced industries that are fundamental to our Nation's future—from nanomanufacturing to cyber-technology. But to truly stay out front in these exciting new fields, it is not enough to invent new products—we can and we must strengthen the ability to make these products too. Establishing the National Network for Manufacturing Innovation is essential to doing just that. I look forward to working with you to realize this vision.

This is just one piece of the Administration's manufacturing agenda; I look forward to returning to talk with you about other exciting initiatives in the near future.

Thank you for the opportunity to appear before you today. I look forward to answering your questions.

The CHAIRMAN. Thank you, Secretary Pritzker.

I will have a few questions and then Senator Thune and then by order of arrival our other two members, and hopefully others will come to join us. This is a very important hearing.

The mindset and the rhetoric that revolves around research and development and manufacturing—you do not find it on front pages. You find it in economic journals, but it just has not grabbed in this maelstrom of whatever it is that we are about up here and in the

world. It gets lost. It is totally devastating. It takes down communities and families like anything I have ever heard, and it lasts for many, many years after the damage has been done, even if something else comes to replace it. People lose confidence.

We have great stories to tell. Manufacturing is making a comeback, as you have pointed out. But we need to be serious again about making real investments if we are to succeed in the long term.

So, Secretary Pritzker, what is the Department doing to capitalize on American ingenuity and the manufacturing research that you have talked about that we have seen in the past few years, and how does the manufacturing hub proposal contribute to that effort?

Secretary PRITZKER. Thank you, Senator, for that question. You know, if you think about manufacturing, it begins with basic research, and it goes all the way through to what do we produce and how do we get it to market. And the Department of Commerce plays a role in a number of places along that spectrum.

First, at NIST, we engage in basic research and we also set standards, which is very important to manufacturing.

We also are active in the supply chain and enhancing the supply chain with the MEP efforts. We are focused there on process improvement.

In the International Trade Administration, we focus on export promotion.

And then with the IMCP effort, which is a really economic development reform, we play a role with our EDA, our Economic Development Administration, in making sure that our investments in distressed communities are coordinated so that those communities can receive investment that can be productive and be successful for the people who live in those communities.

But what is missing is, as you pointed out in your opening statement, this area from basic research to the marketplace. It is sort of a lab to market or the pre-competitive research, as I like to call it. But this area of applied research where it is too early for the private sector to come in because the issues are too risky and they cannot do it alone. They need help from the academic institutions in order to get over the hump. And this is an area that, obviously, this legislation focuses on and one that we at the Commerce Department are enthusiastic about because it fills a gap in a spectrum of support that can be given to the manufacturing industries in our country.

And what I particularly think is so valuable about it is it is also industry-driven. To date, our pilots have been driven by the Department of Defense or the Department of Energy, which is great. I mean, 3D printing is an obvious place for us to focus on composite materials or things like that. But we need it to be broader to where industry thinks that they can take our country and our manufacturing to the next generation.

The CHAIRMAN. It is interesting that between, I guess, about 2000 and 2010, the country lost about 6 million jobs, but during that same period, manufacturing jobs increased by half a million. Now, who talks about that? Very few people but people who care do and are proud of it and have worked for it. And in that period,

the Government has made investments, as have others who will be testifying on the second panel.

I want to put to rest as soon as I can an argument which is often used, and that is we do not think that the Government should be in the business of picking winners and losers. And that is used as kind of a blanket denunciation of virtually anything to do with manufacturing or research and development, even though it is private sector, public sector, and academia. Can you kind of lay that one to rest?

Secretary PRITZKER. Yes. This is not about picking winners and losers. In fact, what is so exciting about the legislation and the proposal ahead is, one, it is competitive. Two is it is taking the best business plans, and three, they are generated by the private sector. The ideas are generated by the private sector, and the solutions are generated by a consortium made up of academia, of local governments, of the private sector.

And if you take the pilot that exists in Youngstown, Ohio, it began with a small investment, \$30 million of taxpayer money matched by \$40 million of local, private sector, and other money. And it has blossomed from—I believe four different educational institutions were involved—to many more and from 60 companies now to over 100 companies involved. This is in a year. And this is around one subject.

And so you can see the potential that can happen as companies as diverse as, take, Northrop Grumman and IBM and small companies like RPM and others coming together to say how do we take this technology and how do we maximize its potential for all different kinds of industries, everything from airplanes to shoes.

And so this is the kind of thing where I think the return—if you look at the return that we got for our investment in the semiconductor industry, which we did in the 1980s, it is something like, in taxpayer dollars, we put in \$500 million, and we got more than 11 times our money back in terms of tax revenue. That is without all the people who got jobs and everything else. So this is one that has great potential for this country.

The CHAIRMAN. Thank you.

Senator Thune?

Senator THUNE. Thank you, Mr. Chairman.

Madam Secretary, I understand that in July of this year, the Administration expanded its NNMI proposal from 15 to 45 regional manufacturing innovation institutes. And it sounds similar in scope to the existing NIST Manufacturing Extension Partnership, MEP program, which I was referring to as “MEP” and I was corrected, which has centers located in every state. Descriptions of the NNMI also sound very similar to the NIST Advanced Manufacturing Technology Consortia (AMTECH) program.

The Department said that the AMTECH program “will provide cost-shared funding to industry-led consortia that will develop technologies to address major technical problems that will spur the adoption of advanced manufacturing capabilities in the United States.” And that is a quote.

The question is, on top of the existing MEP program, the AMTECH program, and numerous other Federal Government man-

ufacturing initiatives, how do you ensure that NNMI does not duplicate existing manufacturing initiatives?

Secretary PRITZKER. So thank you for the question.

So the Manufacturing Extension Partnerships. I really think of them as, first of all, they are consulting with small and medium-sized enterprises to help them have the most up-to-date manufacturing processes so they can stay globally competitive and do not get replaced by some other provider in some other place either in the United States or in the world. So that is a very different function. It is working with existing companies.

The NNMI institutes. First of all, they are a place where cutting-edge research is occurring, where you are bringing together the private sector and academia to say we need to focus on a particular technology that has enormous potential, but it is not at the point where it is in the marketplace. It is really going from the lab not quite to the market. It is filling this gap that exists from I have a basic research idea, but now what I want to do is I need to get that concept to a point where companies are willing to invest in its development. So they are very, very different.

The AMTECH program is a very tiny, little program that is about some technologies, but it is not a place. It does not have the kind of scope that we are talking about. It does not have the kind of matching funds that we are talking about.

This is really to me—and the reason to expand from 15 to 45 is there is enormous demand around this country to do this. I have heard from mayors and different private sector leaders about how excited they are to participate in these consortia because they are an ability to bring these kinds of cutting-edge ideas to a place where then companies can run with them into the marketplace.

Senator THUNE. Well, if you kind of go back to the MEP centers again, they were originally envisioned to become financially sustainable over time, but they still require some amount of base Federal funding to exist today. How would you ensure that the NNMI institutes would not similarly become reliant on Federal dollars, particularly if you are going to increase the number from 15 to 45?

Secretary PRITZKER. Well, I think as conceived, the concept is this is seed dollars to get them up and running and that they are required by their business plans to develop a business plan that makes them self-sustaining over 5 to 7 years. The MEP's are a match funding where a third of the dollars is by the Federal Government and two-thirds is locally, and it is very much embedded in the local marketplace.

Here, I think that the private sector is the key. You have got private sector companies who want to see this research occur but they cannot afford to do it all by themselves.

Senator THUNE. In your prepared testimony, you discussed how investment in innovation is going to create jobs in the U.S. However, there are some economists who argue that advanced manufacturing, which is the type of manufacturing that the NNMI program would seek to support, may only create jobs for a skilled few. Christina Roemer, who served as the chairwoman of President Obama's Council of Economic Advisors, stated that the President's manufacturing plan will probably have only a small effect on job creation.

So the question is how do you respond to those economists who suggest that programs like NNMI will only have a marginal impact on job creation and employment?

Secretary PRITZKER. Well, I think that manufacturing, first of all, creates good jobs and it has an extraordinary multiplier effect, as I think Senator Sherrod Brown was talking about. So today in this country, we have 11.5 million manufacturing jobs, 500,000 of which have been created over the last several years. To support those 11.5 million jobs are 5.7 million jobs in logistics and software, the highest multiplier effect of any of our industries. The jobs also are a key path to the middle class for Americans because the wage and benefits in advanced manufacturing are 17 percent higher than other sectors. So this to me is a great place for investment because I think we are creating very good jobs, stable jobs.

One of the important things to keep in mind is this notion of we need to keep production close to home, and the reason is because of the virtuous cycle that occurs on the, if you will, factory floor which is the innovation that is talked about. It is extremely important, as we produce here, that innovations occur by those who are actually there producing. And that is something, whether it is the yoghurt conversation that we were just having or others. And that has been widely studied, the importance of keeping manufacturing here.

You know, also frankly we do know that innovation is a key driver to economic growth. As I said earlier, two-thirds of R&D comes from the private sector. 70 percent of that is in manufacturing. So this all helps our economy remain globally competitive.

Senator THUNE. Thank you, Mr. Chairman. My time has expired. The CHAIRMAN. Thank you, Senator Thune. Senator Booker?

**STATEMENT OF HON. CORY BOOKER,
U.S. SENATOR FROM NEW JERSEY**

Senator BOOKER. Thank you very much, Mr. Chairman.

First and foremost, I want to thank the Chairman for this great opportunity. I am told that when you are as low in seniority as I am, about 101st in seniority in the United States Senate, that you do not always get the committees that you want. This is something I have been dreaming about being a part of since I first started running for the United States Senate. It is an honor to have you as chairman. And frankly, as I look at the issues facing the United States of America as a whole, I know that the future of our country's strengths and power will not be determined by our military, but will ultimately be determined by the power of our economy. And the privilege to serve on this committee that to me touches that very core problem we have with jobs, economic growth, is truly a privilege. And I thank you for this opportunity.

The CHAIRMAN. We are glad you are here.

Senator BOOKER. Thank you.

Of course, to Ranking Member Thune, I want to thank you as well for this opportunity to serve.

This is an issue—first, I feel like we are both sitting in our first Commerce hearing. So thank you. You have been somebody who

has been a friend and someone who I have respected for a long time.

You know, in Newark, when I was Mayor, we focused on this idea of job creation in every single way. It was the biggest issue that my residents would talk to me about on a daily basis, looking for jobs and opportunity. We did a lot of analysis on our economy. And one of the things we discovered was the incredible importance of our manufacturing base within Newark. Now, in Newark alone, we have about 400 manufacturers. In New Jersey as a whole, we are an amazing manufacturing state, over 9,100 manufacturers. They provide over a quarter of a million jobs within our state. That is direct jobs, not the ancillary jobs in transportation and logistics. It adds about \$38 billion to our gross State product.

And one of the things I did as Mayor was to bring in the Brookings Institution to begin to help us to analyze this sector in a very pragmatic way. We wanted to grow, grow, grow and find ways to create more and more jobs. And we found a lot of practical things that rolled out about it that I felt actually a little bit impotent to deal with as a mayor, which were really national issues. And I am really grateful to have this chance to bring what we see as some of the biggest drivers to manufacturing growth to have a discussion with you.

One of the first things that becomes obvious is while American consumption is pretty significant, 95 percent of all consumers globally are outside of America. And one of the first things that we saw with our manufacturers is that we were not doing enough to help expand American exports. Now, there is obviously a lot going on, but when you talk to manufacturers in States like New Jersey, obviously they are going to have issues with export financing, navigating the complex web of rules of the foreign markets, and then finding specific partners overseas, which there is a demand out there, but a lot of those are difficult to deal with.

Now, obviously, the Foreign Commercial Service is critically important. But the one area I want to hone in on and ask you a question on is Commerce's U.S. Export Assistance Centers, or USEACs as they are called. What I see is that there is a broad difference in quality in the USEACs. And as mayor, I realized that we can develop a real dashboard on specific metrics within my city departments whether it is Comstat and the police department and elsewhere, once people know they are being measured and what they are being measured on, if you are a manager, you measure the things you care about because people care about how they are being measured.

I am wondering if you would be willing to work with Senators like me to help develop a dashboard which creates much greater transparency for the expenditure of taxpayer dollars but I think would really start to drive the standards overall in terms of the different USEACs that are out there and help us to really be more productive in that connective tissue for manufacturers.

Secretary PRITZKER. Senator, I would be delighted to work with you on that. Making sure that our USEACs are all performing at the highest level is a top priority for me and for the Department and something that I want to make sure that we get right. And helping our companies export is a huge priority for me. Tomorrow

I will roll out our strategy for the Department, and you will find that it is very consistent with the goals that you are talking about because I think this is an enormous opportunity for just the reasons you talked about for our companies at this time and for our country, frankly. Foreign direct investment is another great opportunity because of all the good things that are happening here. So I would be delighted to work with you.

Senator BOOKER. That is fantastic.

With my time running out, hopefully I will get another chance to ask another question.

The CHAIRMAN. Senator Pryor?

**STATEMENT OF HON. MARK PRYOR,
U.S. SENATOR FROM ARKANSAS**

Senator PRYOR. Thank you, Mr. Chairman.

And, again, welcome to the Committee. It is great to see you again.

Secretary PRITZKER. Good to see you, Senator.

Senator PRYOR. Thank you for what you are doing.

Let me just say at the outset I like this idea of this National Network of Manufacturing Innovation Centers. I think it is important.

But I would also like to slow down here for just a minute and ask some specifics. So one thing is there is about maybe a billion dollar price tag on this. And Congress has already authorized and appropriated money for research parks. You may not know this. This kind of predates your time there. But none of that money has been released. My understanding is OMB is basically saying that they are too risky. In fact, I think they put them at the same risk level as nuclear power plants, which does not make any sense to me, but I think if you look at the numbers, that is where they are.

Do you know much about why the research parks have not been funded yet? Are you aware of that?

Secretary PRITZKER. No, Senator, I do not know why the research parks have not been funded. I do not know, but I will look into it.

Senator PRYOR. Yes. I will tell you what. Let's circle back around—

Secretary PRITZKER. I would be happy to do that.

Senator PRYOR. Again, this is part of the same goal that we are all trying to accomplish here, you know, trying to get innovation and research and a lot of these research parks—they do not have to be, but a lot of them will be affiliated with universities.

Secretary PRITZKER. Is this the program that is part of the America COMPETES Act, the loan guarantee program?

Senator PRYOR. Yes.

Secretary PRITZKER. So I do have an update on that, which is what is happening is EDA has been working with—since EDA did not have the expertise to stand up or we had not developed the expertise in the loan guarantee program—we have been working with Treasury who does to help us. By the end of the year, we will have a contractor in place to begin to put that in place. So that is as far as we have gotten with that effort. But I do not know about OMB's judgments on this, and I am happy to get back to you about that.

Senator PRYOR. That would be great. We can talk about that. I do not want to take all the Committee's time. But thank you.

And also, if I understand the numbers, the administration is asking for an additional 15 centers that will be funded for 7 years. I am kind of curious about 7 years because typically 5 years is how we do something like this. And also I am wondering about cost-share and kind of logistically how this will work.

Secretary PRITZKER. So as I understand the way the program is proposed, the cost-share is—first of all, it is a race to the top type program in the sense that there has to be matching funding. And what we have seen in the first pilot is that the Federal Government put up \$30 million. The local participants and the private sector put up \$40 million, including the universities. Now what you are seeing is—and you will hear later from the American CEO of Siemens—you are getting contributions of value in the hundreds of millions of dollars. So it really is the classic sort of venture capital kind of money that the Federal Government and the taxpayers are putting up. It is serving as a catalyst for bringing people together that want to see this research occur. So I think it is, from a money standpoint, a terrifically good investment.

In terms of becoming self-sustaining, that is where judging the business plans becomes important because you have to make an assessment, do you believe that these things will ultimately support themselves. And that is a requirement.

The other exciting part about it that we have not really talked about is there is also a workforce training aspect because the hope is it will be like what happened in Albany, which is you begin to create a center of excellence or an institute, and then what has happened in Albany is you have billions of dollars of investment going in around the semiconductor industry. And I talked to not just the semiconductor manufacturers who are there, but I talked to everybody from networkers and others who were supporting the supply chain of the semiconductor industry. And you have got this flourishing economic ecosystem that is going on. And I would envision that what is happening—and you will hear from those who are participating in a few minutes. You know, that should happen in Youngstown and in our other institutes as we stand them up. They build on one another, and particularly when you have the number of private sector participants who want to see this kind of technology get to a point where they can then put it in their products.

Senator PRYOR. One last thing. This is supposed to be part of a national network. Is that defined? Do we know sort of what the roles are and how the coordination will work?

Secretary PRITZKER. I think the concept is that the Commerce Department will serve as sort of a convening of the networks so that best practices can be shared and things like that. But each institute has to be self-sustaining itself.

Senator PRYOR. Thank you.

The CHAIRMAN. Senator Cruz? My apologies.

**STATEMENT OF HON. TED CRUZ,
U.S. SENATOR FROM TEXAS**

Senator CRUZ. Thank you, Mr. Chairman.

Madam Secretary, welcome back.

Secretary PRITZKER. Thank you.

Senator CRUZ. It is good to see you.

Secretary PRITZKER. It is good to see you.

Senator CRUZ. At your confirmation hearing, we had a very good conversation on a number of issues, and one of the things we discussed at your confirmation hearing was that at the time I asked if you would commit, during your first 100 days as Secretary, to identifying at least three regulations that were overly burdensome and that were impeding economic growth. And you very graciously responded at the time and agreed to do so. Indeed, what you said at the time was that it is extremely important to look at the regulatory environment and that you would enthusiastically work to identify those regulations that could be either streamlined or repealed to allow for the private sector to generate economic growth.

It has now been 100 days and you are back before the Committee. So I wanted to give you the opportunity to report on the progress of those efforts.

Secretary PRITZKER. Well, Senator, I appreciate that. Let me put it in the context of, first, the President's regulatory look-back and then talk about the things at the Department of Commerce that I have personally looked into.

So in the President's regulatory look-back, there have been about 500 initiatives to reduce costs and simplify processes, saving about \$10 billion. So, for example, at the Department of Labor, they simplified hazard warning for workers and yet, at the same time, added greater safety, and that had a value of about \$2.5 billion.

What I did at the Department of Commerce is—there are a couple of areas, since what we regulate is in certain areas. So I went to the various areas that we regulate and asked what are we doing to make it easier for commerce to occur. I talked personally and met with a team, the Under Secretary at BIS. We are in the process of implementing export control reform. We are removing 1,000 items which had a more onerous licensing process requirement, removing thousands, not 1,000, but thousands of items. And what that allows an exporter to do is to export items faster, those that require a license, and they no longer pay a per-item fee. And as well, it also strengthens our defense because it allows for greater interoperability because our allies have been shying away from using American parts because of the licensing process. And so this is helping to make our parts supply just easier frankly.

So at BIS, I got very involved in trying to understand what we were doing and working with them, as well as the Director of our Patent and Trade Office. The America Invents Act requires us to provide more certain and timely patents. And I had explicit conversations personally with the Acting Director at the time of the Patent and Trade Office and talked about, OK, we have this backlog. What are we doing to address the backlog and what are we doing to create greater certainty in the patents that we are giving so that there is less vulnerability to those who receive them.

The patent backlog is affected by a number of things, the number of people that we have to adjudicate patents, and we have a number that can allow us to address the backlog over a couple of years, bring that backlog down to an inventory that we would like. Right now we have a backlog of about 560,000 patents. We would like to be running with an inventory of 350,000 patents. We have about 80,000 patent adjudicators. They can each do a certain number.

And so we know precisely how long it will take us to reduce our backlog.

And so I am very focused on the metrics so that I can pay attention so that we can get—you know, innovation depends on us being able to deliver this quickly. And so I am working with the director and keeping track of what is happening there.

I do have to say sequester is hurting that process because even though we are a fee-for-service, we have money that is sitting in the bank account that we cannot access that is affecting our IT spend, which would allow us to get at this a bit faster. So that is a challenge we are facing because of sequester.

Senator CRUZ. Let me ask, if I can, one final question because my time is expiring.

I just came from a gathering of a number of franchisees who were small business owners, owners of fast food restaurants, burger chains, that are experiencing very significant hardship because of the burdens of Obamacare, and they are having difficulties. They are forced to reduce their employees to part-time work, to 29 hours a week, which is impacting the most vulnerable among us.

And we have also seen in recent weeks now over 5 million people across this country losing their health insurance, a significant number of whom are small business owners who were in the individual marketplace.

And so I wanted to ask your judgment for those 5 million people who are losing their health care—in your judgment, should they be able to keep the plans that they have now?

Secretary PRITZKER. Well, Senator, you know, I have to confess that that has not been my area of focus, the precise structure of Obamacare. But what I would say is that the goal is for everyone to be covered and the goal is for—Obamacare has also been set up in a way to bring deficits down. So I think we have to take a bit of the long view right now and get the problems solved that we are facing so that we can see the programs actually work as intended.

Senator CRUZ. But do you think that people should be able to keep the plans that they have now and that they like?

Secretary PRITZKER. You know, there is a knee bone/shin bone question here which is what is available and how does it work and how does it affect the actuarial numbers. So I do not really know how to answer a question for 5 million people except to say that it has to be a system that is integrated that can work. Obamacare has to offer—make sure that if someone has a certain quality—the goal is for there to be a certain quality of health care, as well as that it is such that we have enough participants that the insurers can cover everyone.

Senator CRUZ. Thank you, Madam Secretary.

Secretary PRITZKER. Thank you.

The CHAIRMAN. Thank you, Senator.

Senator Ayotte, you have barely had a chance to sit down, but you are up.

**STATEMENT OF HON. KELLY AYOTTE,
U.S. SENATOR FROM NEW HAMPSHIRE**

Senator AYOTTE. Here I am.

So thank you very much, Secretary Pritzker. It is an honor to have you here.

And my first question is a pretty easy one for you. Will you come to New Hampshire?

Secretary PRITZKER. I'd love to come to New Hampshire.

Senator AYOTTE. OK, very good, because we really are a small business state and I think that certainly the insight you will hear from our manufacturers, which is the topic of today's hearing, but other small businesses in the state, will be very helpful. And I really want to get you to New Hampshire to talk to our fishermen because I am concerned, as you and I talked when you were nominated, about the impact that the catch share regulation is having on them. So if you say yes, I will take it at that. I appreciate it. We would love to have you. And I know I speak for my colleague, Senator Shaheen, who would like to have you there as well, and we can do a joint visit to the state.

What I would like to ask you about is the issue of spectrum and where we are in terms of the sharing of spectrum, particularly the issue that we have across government sectors between DOD and your position as a new Secretary of Commerce trying to lead the sharing of spectrum and/or auctioning off more spectrum for the private sector. And as you know, the Administration has had a goal of freeing up about 500 megahertz of spectrum within 10 years.

Where do you think we are on this? Can you update us? And what do you think you can do to move this forward? Because I feel like we have had a lot of discussions on it, but we are not really making progress.

Secretary PRITZKER. So, Senator, what I would love to do is give you a specific update. I do not have that with me. So I would like to make sure your office has it.

What I have done is, working with our Under Secretary at NTIA, is to make sure he understands how important this is and that we are moving the ball forward to free up more spectrum, which is an objective not only of you but also of the President. And so this has been a high priority for us.

I do not have at my fingertips the latest statistics but I will get that to your office.

Senator AYOTTE. Perfect. I appreciate the update on it and appreciate your leadership in helping us move forward with this. I think it helps everyone. It helps us in terms of the issues. Obviously, we need to protect our national security with the DOD access that they need, but also the opportunities for economic growth that we need to make more spectrum available.

And then finally on the fisheries issue, I know I am going to have you come to New Hampshire, but since you have been in your position, do you have any thoughts on how we can better help our fishermen with what they are dealing with regarding the catch share policies? And particularly, obviously, in New Hampshire last year, there were 22 active boats in the fishery and this year we have only had 14 and really only 4 boats are actually fishing right now. So I just want them to continue to exist and to thrive and grow.

Secretary PRITZKER. Well, Senator, I know how challenging the catch share is, and I understand the impact it is having on fisher-

men, on their families, on the culture in New Hampshire. And I appreciate your efforts working on the disaster relief effort as well.

You know, one of the things that I did after my confirmation hearing and after I was sworn in was we did put John Bullard in place as our Northeast Administrator to work with the fishermen every day on trying to manage through what is a challenging period.

The other thing we have done is we have been covering observer costs for both 2013 and 2014, and we want to work with you as the Magnuson comes up for reauthorization as to how to best proceed with that.

Senator AYOTTE. Good. Appreciate it.

Now, you had tremendous private sector experience before you came here. with issues that impact the growth of manufacturing in this country. Would you agree with me that our tax code has an impact on the growth of manufacturing in terms of tax rates and our competitiveness around the world and, obviously, our regulatory climate as well? Are those two key issues we have to get at if we want to grow manufacturing in the country?

Secretary PRITZKER. Well, I will start with the tax code. You know, I support the President's position on corporate tax reform, to bring the rate down and particularly bring the rate down as well for manufacturers to the 25 percent area. I think that can be very helpful in terms of stimulating manufacturing and keeping our companies not just in manufacturing, but our companies in general globally competitive. I think it is extremely important.

Senator AYOTTE. Thank you.

The CHAIRMAN. Thank you, Senator.

Senator Blumenthal?

**STATEMENT OF HON. RICHARD BLUMENTHAL,
U.S. SENATOR FROM CONNECTICUT**

Senator BLUMENTHAL. Thank you, Mr. Chairman. Thank you for having this hearing.

Thank you, Madam Secretary, for being here today and for the great work that you have done so far and your willingness to serve in this very, very important role.

I would like to focus on the Manufacturing Extension Program—I know you are familiar with it—which I believe is a key example of how public-private partnerships can help our manufacturers invest and grow.

We have in Connecticut CONNSTEP which has delivered critical business assistance to about 467 businesses with only, believe it or not, about \$2 million in combined funding and about a \$591 million impact on the overall bottom line in retained sales. So the Connecticut Center for Advanced Technology is also a nonprofit that provides critical individually tailored support to those kinds of businesses with a focus on technological innovation.

I guess my question is how can we make sure that more small- and medium-sized manufacturers have access to programs like CONNSTEP and CCAT in Connecticut, as well as other programs nationwide, that help them with both business innovation and technological innovation. And can we expect that manufacturers

would benefit from that kind of public-private partnership in your view?

Secretary PRITZKER. Senator, I think the Manufacturing Extension Partnerships provide a really vital service to our small and medium-sized enterprises. They work to help those enterprises stay globally competitive by sharing with them the best practices that exist so they can remain robust participants in the supply chain for the OEMs. So I think it is an extremely important undertaking that we have.

The Manufacturing Extension Partnerships Advisory Board did produce a report suggesting—today we fund—about a third of the Manufacturing Extension Partnership work is funded federally and about two-thirds is funded locally. They recommended that we move from a 1-to-2 to a 1-to-1 funding. Obviously, that requires legislation, and that would be something we would be open to working with you if that is something that you thought would—

Senator BLUMENTHAL. Great. I would welcome an opportunity to work with you on it.

Let me ask about another area that is really of interest to me, and I am sure that you know much more about it than I do. 3D printing is an incredible technology. As you know very well, the National Additive Manufacturing Innovation Institute, recently renamed “America Makes,” is a really important and unique place where a lot is happening, and 3D printing could fundamentally change our national security and workforce needs.

How can we make sure that our investment in these kinds of programs translate into more jobs, which is such a challenge for us? Even at a time of heightened and increasing productivity, there is still a need for more jobs. And I know training plays a role, job skill development. I would be very interested in your perspective.

Secretary PRITZKER. Well, Senator, this is an issue that is near and dear to my heart. And what I so support and the administration so supports in the Brown-Blunt bill is that one of the criteria for selecting different institutes is that it incorporates training and skill training. And what is so exciting about what has been happening in Ohio is they have begun by exposing—they are only a year into it, but kindergartners through post-graduates are engaged in the program, the NAMII program in Youngstown. So you have young children being inspired by what is the possibility of 3D printing and then you have workforce training being offered, whether it is Siemens making available hundreds of millions of dollars worth of software so that we can train a workforce in that area to be able to support the manufacturing of different types of products all the way through post-graduates that are being trained. So that is an extremely important part of these institutes that are being proposed. It is not just the research. It is not just bringing it to market, but it is also making sure that we can have a supply chain and a workforce that can support all that.

Senator BLUMENTHAL. Thank you. My time has expired, but this whole area is tremendously exciting and I really want to thank you for your leadership on it. Just your interest and commitment I think will hopefully inspire others to be interested and committed as well. So thank you very much, Madam Secretary.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator Blumenthal.

First of all, I want to give a little buck-up to the second panel. We know you are there and we want your spirits to remain high. If you need a Coke or something, that can be easily provided. But we do have the Secretary here and there are a couple of more questions that some of us would like to ask her, and we have lots of time in the afternoon.

I want to get again at this thing which sort of bugs me, and you mentioned it with the sequester problem, and that is the idea that if Government somehow is involved, the process is polluted, not really American, or something of that sort. You had a lot of experience in the private sector. Some of the skeptics say that the manufacturing hubs are too costly or they say that there is no need for a direct Federal role because you have academia and you have the private sector. Now, my own view is much of this skepticism is based upon ideological opposition to the Federal Government's involvement.

My question is: as a former CEO and in your capacity as Secretary of Commerce what do you think of this argument? Does it make a practical business sense for the Government to step back from the investments in innovation and manufacturing?

Secretary PRITZKER. No. From my experience in the private sector, there are some things the private sector cannot do itself, and they are either too risky or too complicated. And they need the help of the Government to be a catalyst, and this is what the NNMI does. It is a great structure because it is forcing the private sector to invest in an area it is interested in but in an area where it is not going to do it all by itself. This is a good role for the Government to play. And I would say that as a private sector representative, as well as Secretary of Commerce, because this is not research that any one company will undertake by itself.

In Youngstown, there are 60 companies that came together to make this happen, and they matched it with \$40 million of funding and people, and universities came to the fore to bring their intellectual capital and the research that they are doing, as well as then you have workforce training, et cetera.

So to me, this is exactly the kind of role the Federal Government can play. Otherwise, it is not going to happen. And that is why I used the example around semiconductors. If you speak to the Intels and the IBMs and the Global Foundries in Albany, they would not do that work themselves. They are trying to expand. The work that is going on in Albany today is they are trying to create a 450-millimeter chip wafer. Currently chip wafers are 300 millimeters. It will allow for 50 percent more computing power or 50 percent faster computing power. No one of those companies will address that issue by themselves. The machine just to test if it works cost \$100 million. It is too risky. So this is exactly the kind of thing that we should be doing, and I think that the return on investment has been proven in Albany and is being proven right now today in Youngstown. And this is the kind of thing that the Federal Government can do and it has got great return for the taxpayers' dollar.

The CHAIRMAN. I thank you.

Senator Thune?

Senator THUNE. Mr. Chairman, I will pass.

The CHAIRMAN. Oh, Senator Blunt has reappeared.

Senator BLUNT. I have, but I will assume the questions I was going to ask have been asked.

The CHAIRMAN. You are going to assume that? OK. Bipartisanship.

Senator Booker?

Senator BOOKER. Thank you very much.

I really appreciate your point, Madam Secretary, that this is not philosophy. It is really about where can we invest and get the biggest return. It is all about the ROI [return on investment], and frankly, our competitor nations are making these investments and pushing past us in areas they should not push past us. But, obviously, as I talk to manufacturers on the ground in New Jersey, one of the biggest concerns, again, is this idea of concentrated costs, diffuse benefits so people will not necessarily make those costs.

But one of the costs that we are not doing a good job in America—because when I talk to manufacturers, they are worried about a skills mismatch. There are actually job openings. There is a lot of job openings, and there is a lot of people looking for jobs in America. And so what I see in New Jersey from talking to manufacturers is there is this mismatch. There are high-paying middle class jobs available, but we are not preparing them.

Now, looking around the country, there are some great examples of people stepping up to do these. These are islands of excellence when what we really need is a hemisphere of progress. And so you see places like Chicago, the Austin Polytechnic Academy which is doing a great job at the lowest levels. You have already mentioned that. We are talking K through 12 education, preparing people for these very high paying jobs and internships toward those jobs, which you do not need to go to higher education to get a well-paying middle class job. Like the manufacturing of old, you can raise a family on these jobs. And in Buffalo I am seeing that as well. But it is too small. We need to get bigger.

And so I really would love to hear from you about what the Federal Government can do, understanding this concept of ROI that the private sector gets but we do not seem to get necessarily in Washington. What can we be doing to correct for that mismatch and prepare our workforce for 21st manufacturing jobs?

Secretary PRITZKER. Well, Senator, I really appreciate the fact you mentioned Chicago, which is my hometown, and actually the skills mismatch program in Chicago is one that I started.

Senator BOOKER. I was told it was paid. It could be a little obsequious in these hearings.

Secretary PRITZKER. Mayor Emmanuel came together with the private sector to fund an effort to take the longer-term unemployed and help them get the skills to meet—in Chicago—I know the statistics there—there are 240,000 unemployed and 200,000 open jobs. At least that was the case when I left. I hope it is better than that today. And how do we address that problem? Right? That is the problem you are talking about.

And it began with really going to companies and dealing with the perception issue. It is more than a perception issue. One is, will you hire someone who has been unemployed for over 6 months? Recruiters are not rewarded for doing that. It begins there and then

started with, OK, who could actually fill a job today and who needs training, then arranging the training, once you have the employer who is willing to actually hire the unemployed. So there is a number of things that could be done.

What could the Federal Government do now? It is really a question of, I think, looking at workforce funding and on-the-job training dollars and making it more flexible. What we found, it was very difficult to access the WIA money to actually support those efforts that have high effectiveness. And so that would be an area that I would say that is worth exploring.

I think the other is to celebrate the structures that are working. You know, it is to do what you are saying. Here are places, centers of excellence. How do we get to something—you know, you said it. It was very articulate. I cannot remember exactly. But how do we really explode those excellent offerings and make sure that they are occurring in every city so that we can address this problem? Because what I heard on my listening tour was one of the number one things that every single CEO said to me—and I met with hundreds of CEOs during the first 100 days of my being in my position—was I have a skilled labor challenge. It is across the country. It did not matter if I was in Albany, Portland, Nashville, or Orlando and everywhere in between. Everybody talks about this problem.

And what is exciting to me is you are starting to see that industry is really stepping in to also fill this void. They are recognizing that they need to play a greater role, which is what we were hoping for.

Senator BOOKER. If I can push on you just a little bit and beg for a moment more from the Chairman. That is great for large industries, but most manufacturers are very small and it is very hard for them to make investments in filling that gap. So, therefore, there are some programs which you seem to allude to that are Government investments that have a tremendous payoff, whether it is WIA dollars, which are flexible, as I have learned as a mayor. So, therefore, we must have a role—the Federal Government. If everybody is hearing, if you have heard as Secretary, a chorus of people saying there is a skills gap, there is a skills gap, and I heard it with small manufacturers in places like Newark, there must be a role here for the Federal Government.

Secretary PRITZKER. I think flexibility and on-the-job training dollars is one. Another is working with the community colleges. But that is a local effort that needs to go on which is to really get industry members in a local area to come together and agree on criteria for training, put curricula together, and have recognized credentials that can be used across so that one manufacturer does not have to support it all themselves, but they can work together. And those solutions—we can be a catalyst I think at the Federal level, and it is something—the Department of Commerce—I am committed to make as part of our agenda is really to be a catalyst for those kind of local solutions coming together because I think ultimately on the ground it has to occur locally.

Senator BOOKER. In other areas we see in the Federal Government incentive pools of Federal dollars that motivate people to come together and create those coalitions.

Secretary PRITZKER. Right.

The CHAIRMAN. Thank you, Senator.

Senator Blumenthal, I do not want to pass over you, but I do not dare pass over Senator Markey.

Senator BLUMENTHAL. I will certainly yield to Senator Markey.

The CHAIRMAN. Will you?

Senator BLUMENTHAL. Absolutely.

The CHAIRMAN. Reserving your time.

Senator Markey?

**STATEMENT OF HON. EDWARD MARKEY,
U.S. SENATOR FROM MASSACHUSETTS**

Senator MARKEY. Thank you, Mr. Chairman. Thank you, Senator, very much.

You know, the whole key here is we have to find a way of ensuring that we link up the investors with the inventors, the professors with the producers and create kind of an environment where innovation is at the heart of what is happening. And that is what we were able to do in the 1990s in telecommunications. And the chairman and I in the House and the Senate—we passed three bills that ultimately led to \$1 trillion worth of private sector investment that created Google, eBay, Amazon, Hulu, YouTube, and the first generation and now Twitter and Facebook in the second generation, just unleashed it because we created the right policies and passed those three laws which unleashed it, created the broadband revolution and the spectrum-based revolution.

And energy gives us kind of a similar kind of opportunity because we know that by the end of the 21st century, there is going to be a huge revolution in the kinds of energy that we use. And we know that it is the same types of people who led the way, those investors, those young venture capitalists, those young technology gurus who are ready to go, ready to invent this new way in which we produce energy in our country.

I have introduced legislation to kind of look at this Consortia-Led Energy and Advanced Manufacturing Networks Act. It is very similar to Senator Brown's and Senator Blunt's legislation kind of focusing upon this issue. In the Waxman-Markey bill back in 2009, we actually included a whole hub program for energy across 10 universities, 10 different parts of the country in those metropolitan areas where companies, universities, States could apply so that we could change the culture and bring in people, break down the barriers and make it possible.

So from my perspective, what we are talking about here today—and Professor Schmidt from MIT on the second panel is kind of representative of who we think we are in Massachusetts. We are the Bay State, but we are also the “Brain State.” We focus upon these areas, and we know that at the end of the day, there are going to be thousands and thousands of very small companies that come up with the ideas, but you got to create the culture where you draw the smartest young people and they are able to do it.

So I guess from my perspective, what I would ask you is just to step back for a second and tell us what is the one thing you want us to remember from your testimony. What is the large picture you

want us to take away from this in terms of where our country has to go in this area?

Secretary PRITZKER. Well, Senator, I think the most important thing for us to remember is there is a gap that exists in the process of going from basic research to product and that that gap can only be filled with a public-private partnership. It requires us to bring together the private sector, universities, local governments, and Federal funding can be the catalyst for that kind of initiative to then take off. And we see it in Youngstown. And so that is fundamentally what I think is—this is a role, an important role, for the Federal Government to play, and the return on investment is high.

Senator MARKEY. Yes. And, you know, I agree with you. And let's be honest. OK? The incumbent industries are averse to investments in new technologies, competing technologies. And that is just the nature of all of these industries. The telecommunications industry—they were very happy with us still have black rotary dial phones 60 or 70 years after they invented them, renting them from them. That model was not going to change. And the same thing is true in this energy field. Thank God that Alexander Graham Bell would no longer recognize his telephone network, but he could in 1996. And we have to actually aspire to a day where Thomas Edison could not recognize his electricity grid, but right now he can. It looks a lot like the original design.

And so we just have to put in place the policies to create the incentives where that change takes place. That is where the wealth generation is going to occur in our country. And it is really what I think this administration has been all about, smart grid, investment in wind and solar, biomass, geothermal, investment in new electric vehicles, investment in ways in which you can partner a cable and a telephone company with their smart technology, with energy efficiency in homes.

So all of this is all part of the culture we have to create in the hubs in all parts of the country because all parts of the country can contribute. I think they are central to having our economy be the generator of the vast bulk of these jobs. And I really do praise your administration because you have been at the cutting edge of putting together these kinds of consortia.

And I thank you, Mr. Chairman, for holding this hearing.

The CHAIRMAN. Thank you, Senator Markey.

Senator Blumenthal?

Senator BLUMENTHAL. Thank you.

I just have a quick question because I want to be respectful of the next panel.

The CHAIRMAN. We are past that point.

[Laughter.]

Senator BLUMENTHAL. I still want to be respectful of the next panel.

[Laughter.]

Senator BLUMENTHAL. To go from Senator Markey's very eloquent global perspective to the more narrow what can we do in terms of practical measures to enable job creation, recognizing that funds are going to be limited, at least for the foreseeable future, I have proposed as a method of creating funds for job training and

capital investment that there be a manufacturers' reinvestment account similar to what is done by individuals in saving tax-free so that they can then use money for retirement. If manufacturers or others are enabled to, in effect, take money from their revenues and profits without taxing it, save it, then invest it in either equipment or job training at a lower tax than they would have otherwise paid, there may be incentives but also the ability to save for, let's say, 5 years, which is the amount of time contemplated.

So I would encourage the administration, joining in Senator Markey's praise, to be continuing to innovate and to be creative in the way that you have and the way that you did in Chicago when you were there.

Thank you.

Secretary PRITZKER. Well, thank you. And innovation and job creation are top of mind for this administration and a high priority.

Senator BLUMENTHAL. Thank you.

The CHAIRMAN. Secretary Pritzker, you have been terrific. I have a number of friends in the Commerce Department and they all think that you are too.

Secretary PRITZKER. That is very kind.

The CHAIRMAN. What I think they appreciate and what I know I appreciate is the force that you bring in terms of personal experience, personal willingness to make decisions and move forward. And we have not had that for a while, but we have that in you.

And I really appreciate your taking the time to come and testify.

Secretary PRITZKER. Thank you very much. Thank you, Senators. I appreciate it.

The CHAIRMAN. Now I have to do my best to get in good with the second panel. It is such an important subject, I think the second panel actually is not going to be upset by having to wait just a bit.

Eric Spiegel is the President and CEO of Siemens Corporation, Washington, D.C. That is a rather amazing corporation.

Dr. Martin Schmidt, who is Associate Provost and Acting Provost, Professor of Electrical Engineering, Massachusetts Institute of Technology in some place called Cambridge, Massachusetts.

Michael Garvey, President and CEO of M-7 Technologies, Youngstown, Ohio.

And Dr. Terry Brewer, President of Brewer Science, Inc., Rolla, Missouri.

And we welcome you all. You are sort of the manifestation of all that we have been talking about. So once the water is poured, I am going to call on you, Mr. Spiegel.

**STATEMENT OF ERIC A. SPIEGEL, PRESIDENT AND CEO,
SIEMENS CORPORATION**

Mr. SPIEGEL. Thank you, Chairman Rockefeller and Ranking Member Thune and the rest of the members of the Committee, for having me here to testify today on the role of manufacturing hubs in the U.S.

Let me just start off by saying that Siemens is a strong supporter of the concept of manufacturing hubs, and let me give you a couple of reasons why in my time here.

One is Siemens is one of the largest technology and manufacturing companies in the world. We operate in 190 countries. We

have well over \$100 billion in revenue. We have over 375,000 employees. But the U.S. is our biggest market. It is about 25 percent of Siemens. We have 60,000-some employees, 130 manufacturing plants, and we do about \$25 billion worth of work here. And we are a net exporter of several billion dollars.

The concept of manufacturing hubs we think is very viable. If you take a look at Germany, which I think a lot of people would say is one of the world's leaders in manufacturing and, in particular, advanced manufacturing, and has a huge export machine of manufactured products, they have long had for decades a concept similar to these hubs called the Fraunhofer Institutes. In fact, they have over 50 of them. So we are talking about going from maybe 1 to 15 to 45, but in Germany we have 54 just in Germany alone, which is a much smaller country than, of course, the U.S.

The bigger thing is that Siemens has invested in the last 10 or 12 years about \$25 billion here in the U.S. So why do we invest here in the U.S.? Obviously, it is a big market, but we want to get close to customers and we want to get close to our suppliers. Second, we want to be close to a skilled work force. We want to have access to world-class R&D. We want to have a modern infrastructure, and finally, we want to see policies and programs and legislation that really encourage investment, and in particular, since we are one of the world's largest manufacturing companies, in manufacturing. So we really support this kind of a program, this kind of legislation because it would really encourage more investment from a company like Siemens. So that is one big reason why we think this is a good thing, but also experience shows that it really works.

The second key point is if you take a look around the U.S., manufacturing is growing again, albeit it very slowly, most of it in energy-intensive industries really driven by low-cost gas. But we think in the longer run the real resurgence of manufacturing in the U.S. is going to be in what we call advanced manufacturing. And why is it that we think advanced manufacturing is going to be a strong grower? It is because advanced manufacturing is really driven by software and the software revolution. It allows us to do more flexible manufacturing, higher productivity, lower cost, faster speed to market across all industries.

So what does that mean for the U.S.? The U.S. is the world's leader by far in the development of industrial software. The company that we use here in the U.S. is one of the largest industrial software companies in the world. It is called Siemens PLM and we acquired it here in the U.S. We spread the software across the U.S. and we are now exporting it globally.

What does Siemens PLM do? Well, it does all the things I mentioned before that software can do. For example, it was used to design the Mars Rover. It was able to test and simulate the entire flight of the Mars Rover, both the flight and the landing on Mars which, as you may remember, was a very difficult task. It allows Ford to manufacture millions of varieties of the F-150 at about the same cost they could manufacture any one model of the F-150—that software. The third is it allows things like 3D printing which we are using to do artificial knees and hips, basically computerized knees and hips 3D printed going forward. You know, that is some-

thing that I think a lot of us in the room probably will be needing, and I know, Senator Booker, you and I, given all of our years playing football may need more than the rest. So this software enables lots of different technologies.

And so advanced manufacturing we think is the way the U.S. needs to go. It has big advantages, but we need to encourage it more. I think Secretary Pritzker did a good job of highlighting that. And we think the innovation hubs are a way to drive the inventions we have here in the U.S. and then to innovate them, which we really think of as how do we make these things commercially viable and scaleable. There are a lot of little islands, I think Senator Booker mentioned, around the U.S., but we have got to learn to scale this stuff or we are going to fall behind other countries.

The America Makes program, the National Additive Manufacturing Institute in Youngstown is a good example, that on 3D printing. We donated \$440 million of software to Youngstown State University that they are going to use to train people at the university and also at the Additive Manufacturing Institute. And we did that because we want to see that prosper, but also it is good for us because it trains people to use our technology, and we have 70,000 customers in the U.S. and around the world who use that.

So we think, given all of these reasons, that this concept of manufacturing hubs readiness and the Brown-Blunt Revitalization of American Manufacturing Innovation Act is a very strong sign that the U.S. really wants to get into the game of global advanced manufacturing, and we would support that.

Thank you very much.

[The prepared statement of Mr. Spiegel follows:]

PREPARED STATEMENT OF ERIC A. SPIEGEL, PRESIDENT AND CEO,
SIEMENS CORPORATION

Chairman Rockefeller, Ranking Member Thune, and Members of the Committee:

Thank you for inviting me to testify at this hearing on the role of manufacturing hubs in a 21st Century innovation economy.

Siemens is one of the world's largest technology companies. We operate in the energy, healthcare, infrastructure, and manufacturing sectors. For more than 165 years, we have built a reputation for leading-edge innovation and the quality of our products, services, and solutions. I like to say that Siemens is the oldest, biggest company in the world. There are a few that are older, but not as large. There are a few that are bigger, but they do not have a history dating back to 1847. We became the oldest, biggest company in the world because we stayed true to the vision of our founder, Werner von Siemens. As both an inventor and an innovator, he knew how to make things useful and commercially successful. He recognized early on that our success would be determined by our ability to anticipate and engineer the future.

As CEO of Siemens USA, I am proud to serve on the Business Roundtable's Education and Workforce Committee and the steering committee of the Advanced Manufacturing Partnership 2.0, which is a working group of the President's Council of Advisors on Science and Technology. U.S. manufacturing is growing again and becoming more competitive. There is a lot of investment in existing and new manufacturing plants due to low energy prices—driven by the development of shale gas—as well as rising labor rates in emerging countries, and increased productivity in the U.S. This means that more companies are bringing manufacturing facilities back to the U.S. We have already seen over \$90 billion in new manufacturing investments being planned, especially in energy-intensive industries like chemicals, steel, and aluminum.

Siemens itself, which has been doing business in America since 1854, has invested more than \$25 billion in the U.S. in just the last 12 years. We have over 130 manufacturing sites here, export about \$6 billion worth of products each year, and are

proud to be part of the local fabric of communities in every one of the 50 states, the District of Columbia, and Puerto Rico, employing nearly 60,000 people in the U.S. Today, the U.S. is not only by far our largest national market, but also an extremely vital production location, one of our most important research centers, and a key base from which we export to the rest of the world.

As a global company, when we are looking for a new place to manufacture a product, we take five main considerations into account: First, we want to be close to our customers in the leading markets. Second, many of the positions in our company require highly skilled workers, so we look for areas with a commitment to workforce development and higher education.

Third, we want to be close to world-class R&D that we can link to our innovation engine and our supply chain at our manufacturing sites, particularly for early-stage technologies. Fourth, we look for strong infrastructure to get our goods and services to our customers. Fifth, we look for government policies that encourage investment, like the Production Tax Credit, the research and experimentation tax deduction and credit, and the manufacturing innovation institutes being proposed in the Revitalize American Manufacturing and Innovation Act.

For many years, conventional wisdom said that because labor was cheaper elsewhere, manufacturing in America was more-or-less doomed. But that conclusion assumed two things that have turned out to be wrong: first, that cheaper wages would always translate to lower production costs; and second, that the products of the future would essentially be commodities, the kind that could be built of equal quality, with equal technology, anywhere in the world.

Those assumptions were right when it came to making things like textiles and furniture—relatively low-technology products that require relatively little innovation on the front end and relatively minimal precision on the back end. But the assumptions were largely wrong when it comes to high-end products, which require highly skilled workers, high-precision assembly, intensive research, and complex technology.

If you are in the business of building high-technology products—the kind of products that will eventually emerge from the work done in these innovation institutes—then the wages you pay are usually a less significant line-item on your income statement. That makes it possible to build them in America, as cost-competitively as anywhere else, because access to innovators is far more important than access to cheap labor. But here is the catch. If we cannot improve the products we build here, through each new generation, we will not succeed. Constant innovation is the only way to stay ahead of competitors. That means that success in American manufacturing will require us to build technologies and processes that we can constantly improve to stay ahead of our competitors.

That is both the opportunity and the goal of these proposed manufacturing hubs: to take an American invention and innovate it to make it useful, scale-able, and commercially viable. Siemens is in the process of donating \$440 million worth of state-of-the-art software and training to the College of Science, Technology, Engineering, and Mathematics at Youngstown State University. The university will use our gift to support the America Makes manufacturing innovation hub in Youngstown, Ohio, which is devoted to incorporating 3-D printing into mainstream American manufacturing. While 3-D printing has been around for decades, the optimization of 3-D printing in the manufacturing process will drive innovation, lower costs in design, and improve overall efficiency and quality in the manufacturing industry.

That is the kind of competitive advantage that innovation institutes can start bringing to American manufacturing. With each institute focusing on a particular aspect of advanced manufacturing, we can accelerate the commercialization of innovations in the U.S.—which would defy recent decades of conventional wisdom about U.S. manufacturing.

One of the reasons Germany is currently a world leader in the use of robotics in manufacturing and in high-end industrial engineering is that the country has long had dozens of hubs, called Fraunhofer Institutes, each of which brings businesses, university departments, and targeted government funding together to tackle the challenges of commercializing a particular aspect of advanced technology that has the potential to strengthen that nation's manufacturing strength.

The manufacturing strength in the U.S. is being driven by software—helping companies increase flexibility and productivity, while shortening time to market for goods.

The software Siemens is donating to Youngstown State University is called Product Lifecycle Management, or PLM. Siemens PLM is an American success story. The original software was developed in the U.S., by a U.S. company that became part of the Siemens family in 2007. PLM software can bring the real and virtual worlds together in a way that collapses the boundaries between the two. Recently, our PLM

software was used to digitally design, test, and assemble NASA's Mars Rover Curiosity and Elon Musk's SpaceX. This is the same system that Chrysler uses to make cars, Dyson uses to make its vacuum cleaners, and Calloway uses to make golf clubs. This bridging of the real and virtual worlds continues to drive innovation and stimulate the resurgence of manufacturing in America.

The U.S., as the world's leader in software development, has a leg up in the global manufacturing race, but we need a skilled workforce for advanced manufacturing, which is dramatically different from traditional manufacturing. Images of men in overalls carrying their lunch buckets to a factory, hot warehouses, dirty work, and assembly line production have been relegated to the movies. The reality is, today's manufacturing economy is the most sophisticated, forward-looking, and innovative business function in the world today. Customized production has largely replaced mass-production assembly lines, advanced robotics are increasingly doing the dirty, dangerous works of manufacturing, and sophisticated software systems now run huge industrial machinery. Today's factory workers have strong technical and analytical skills, and are just as likely to carry a tablet computer as a wrench. But there is a significant gap in the skills needed for these advanced manufacturing environments and the education and training that today's students and workers receive.

Siemens' donation in support of the America Makes institute in Youngstown includes training in the use of PLM software, and the institute's work includes a large workforce-training element. The software will be used to educate students and prepare them for careers in fields ranging from robotics design to computer-aided engineering to additive manufacturing in a multitude of industries around the world, including aerospace, automotive, defense, energy, high-tech electronics, machinery, and oil and gas. The hub will help prepare a modern workforce in the Cleveland-Pittsburgh TechBelt and throughout the U.S. The America Makes institute is just a short distance from the YSU campus and the school is now attracting students from across the country seeking advanced manufacturing, materials, and engineering degrees.

It is this type of training and partnership that we need to enable more Americans to excel in high-tech manufacturing environments. My participation in the new Advanced Manufacturing Partnership 2.0 is focused on closing this training gap. These new manufacturing innovation institutes can and should incorporate into their work the development of workforce training programs, just as the Fraunhofer Institutes in Germany have a consistent training element to ensure a workforce for their innovations.

This is how we can make manufacturing work in America. But I do not want to paint too rosy a picture. The truth is that innovation is not happening only here. The major advances being made right now in wind and solar technology are being made in Europe. Major advances in bio-fuels are happening in Brazil. The same can be said for batteries in Asia. If we keep taking a back seat on innovation in such critical new industries, there will be a point where we are no longer the leader in innovation. Without a relentless dedication to innovation, the U.S. will be out-matched on the global stage, without recourse.

To prevent that from happening, we must all work together to make the right kind of investments, right now. The Brown-Blunt Revitalize American Manufacturing and Innovation Act and the resulting innovation institutes form an important part of U.S. manufacturing maintaining its edge.

If we get this right, the story of the next decade will not be another one about the decline of manufacturing. It will be about how American manufacturing, once again, saved America's middle class.

I applaud Senators Brown and Blunt for introducing the Revitalize American Manufacturing and Innovation Act. I thank Chairman Rockefeller and Ranking Member Thune for holding this hearing and for inviting me to testify.

The CHAIRMAN. Excellent. Thank you very much.
Dr. Schmidt?

**STATEMENT OF PROFESSOR MARTIN A. SCHMIDT, ACTING
PROVOST, MASSACHUSETTS INSTITUTE OF TECHNOLOGY**

Dr. SCHMIDT. Chairman Rockefeller, Ranking Member Thune, and members of the Committee, thank you for inviting me today to discuss the role of manufacturing in an innovation economy.

At MIT, we have just completed a 2-year study on manufacturing, and we also played a leading role in the Advanced Manufacturing Partnership, and I would like to share with you what we learned through those exercises.

The importance of manufacturing is often said in the context of jobs, economic and national security and innovation. And I want to focus my comments this afternoon on the innovation issue.

MIT's manufacturing study was data-driven. We interviewed and surveyed more than 1,000 firms in the U.S. and around the world. I want to highlight several of the findings from our work.

First, that our manufacturing sector has thinned out.

Second, that there is, indeed, a critical linkage between our innovation capacity and our manufacturing capabilities. And I will refer to that as our production ecosystem.

Last, we need to improve our ability to rapidly scale up products, production of new products based on advanced technologies, and a robust production ecosystem is critical to that.

Regarding thinning out, the most tangible example of this is that we have lost some 5.8 million manufacturing jobs, one-third of the U.S. manufacturing jobs in total, in the decade between 2000 and 2010. As a result, there are far fewer people and places making things in the U.S. This impacts our ability to innovate and ultimately make new products.

The underlying story is the migration away from highly vertically integrated firms. Three decades ago, our large firms housed in one organization all the skills and capabilities to design and manufacture their products. However, capital markets have compelled these firms to be far more capital efficient and focus on their core competencies, consequently becoming asset light.

This has had two important consequences. First, the disappearance of the small and medium enterprises that supported these vertically integrated firms in their regions, as well as the loss of the trained workforce in that region. This has thinned out the production ecosystem in those regions, and as my colleague, Professor Suzanne Berger at MIT likes to say, these remaining firms are "home alone" in the U.S. struggling to advance.

Regarding the linkage of manufacturing and innovation, the success of some firms that have outsourced manufacturing leads to the question of why can we not innovate here and manufacture elsewhere. And Apple is a frequently cited example of a firm that does this well. However, we believe that this is possible only in certain sectors like consumer electronics.

The Gillette Company, I think, is actually an interesting example of how production and innovation are tightly integrated. The disposable razor that you might have used this morning, if it was from Gillette, was first manufactured near some of the most expensive real estate in downtown Boston at the World Shaving Headquarters. Why is that the case? Well, believe it or not, that disposable razor brings together some very sophisticated advanced technology from diamond-like carbon coatings, laser welding, custom-formulated polymers, and precision molding. And Gillette has learned that in order to innovate in these new products, they have to bring together the innovation in manufacturing. And we see this story repeat in many sectors that we studied.

In summary, we find that in most sectors, innovation and production come hand in hand, and if the production shifts abroad, the innovation is likely to follow.

Finally, with respect to scale-up, we found that most firms that are trying to rapidly scale up production face challenges. For Main Street firms, the challenges come in the form of access to capital, particularly aggravated by the disappearance of local banks.

Scale-up is also an issue for startups, and I can give you a very specific example from our work at MIT. This is a product made by a company that spun out of MIT. It is called “Nectar Power.” What it is it is a portable power generator that can recharge your mobile phone when you are off the grid. It will recharge it 20 times, so over about a 2-week period you can use this. This single fuel cartridge packs enough power to be better than by an order of magnitude than the world’s best battery. This work was started by DOD funding at MIT, but the product has taken more than 10 years to develop and in excess of \$100 million in venture capital. Much of this time and money was needed to fill in the production ecosystem. And this firm is still not out of the woods yet, and they are challenged to get the scale-up capital.

We found this story repeats in many sectors as these companies attempt to bring advanced technology products to market where access to capital for late-stage production ramps is a big challenge and often leads to foreign investments or transfer of the production offshore.

To summarize, in order to capture new markets, our firms must be able to scale up production rapidly and the ecosystems and access to capital are key enablers. We have to fill these gaps.

The recommendations of the Advanced Manufacturing Partnership are very much in finding with the MIT study, namely the formation of the network or the hub manufacturing institutes that we are speaking of; second, recommendations around strengthening workforce development that I would be happy to speak to in the Q&A; and last, around the development of advanced manufacturing technology strategies.

Let me, in closing, say that I think there is reason for optimism. Rising wages in other parts of the world and low-cost domestic energy are putting the wind at our back as we think about strengthening our production ecosystem. In addition, I think we are seeing a generation of people that are truly interested in making things, perhaps best embodied by the maker movement. So now is the time to focus on addressing the structural problems that are constraining our ability to accelerate our innovation economy.

Thank you very much.

[The prepared statement of Dr. Schmidt follows:]

PREPARED STATEMENT OF PROFESSOR MARTIN A. SCHMIDT, ACTING PROVOST,
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Chairman Rockefeller, Ranking Member Thune and members of the Committee:

Thank you for inviting me today to discuss the role of manufacturing collaborations in our innovation economy. As requested, I will review key findings on that issue from MIT’s just-released study on Production in the Innovation Economy—“PIE,” as well as the Advanced Manufacturing Partnership—“AMP”—project. I have had the privilege to serve for three years on the faculty committee that prepared

this MIT advanced manufacturing report, and have also served as the Technical Co-Lead on the university side for the Advanced Manufacturing Partnership.

Very often, the importance of a robust domestic manufacturing base is expressed in three contexts; jobs, economic and national security, and innovation.

At MIT, we have chosen over the past 3+ years to focus on the innovation question. Specifically, is a production ecosystem vital to our innovation processes, what level of production is needed, and how can we strengthen this area? This is not to say that matters of security and jobs are not very important, but on innovation we believe we have something particular to say, and further, as you know, technological innovation is the dominant factor behind economic growth and therefore jobs.

The MIT Production in the Innovation Economy (PIE) Study

MIT's manufacturing study was led by 20 members of the MIT faculty from a wide range of fields—engineering, science, economics, political science and management. It was data driven, undertaken over three years. It included interviews with over 250 manufacturing firms, small, medium and large. We conducted firm interviews in 21 states, but focused particularly on in-depth interview efforts in 4 states—Ohio, Massachusetts, Georgia and Arizona—which have quite different manufacturing economies and sectors. We also studied production in some 150 startup and entrepreneurial firms. We conducted interviews with an additional 78 firms in 7 other countries, and tried particularly to understand the manufacturing success of firms in Germany and China. We conducted, too, a major survey on workforce needs, sampling hundreds of manufacturing firms. Our report was recently released in book form; a second volume will come out this winter with the detailed backup chapters for the first overview volume. A preliminary summary of the MIT report can be found at: <http://web.mit.edu/press/images/documents/pie-report.pdf>.

Summary of Three Key Findings

We found three important developments.

- (1) Our manufacturing sector is thinning out—we need to find ways to strengthen the supporting “infrastructure” in our manufacturing sector.
- (2) There is a critical relationship between our innovation capability and our production capability.
- (3) We need to improve our ability to rapidly “scale up” production of new products based on advanced technologies.

I'll briefly summarize each finding, and then discuss how the Advanced Manufacturing Partnership effort ties to these findings.

(1) Thinning Out

First, our report found that the U.S. manufacturing sector was thinning out. We lost some 5.8 million manufacturing jobs—about 1/3 of all U.S. manufacturing jobs—in the decade between 2000 and 2010. There are ongoing debates about the origin of these losses from productivity gains to outsourcing. However, one fact is indisputable; there are far fewer people and places ‘making things’ in the U.S. than there were in 2000. This translates to a thinning out of the production eco-system that we rely on for innovation in new products and a corresponding loss of investment in plants and equipment that position us to capture the manufacturing of these products.

But there is an underlying story here—the disappearance of the vertically integrated firm. Three decades ago our large firms housed under one organization all the skills and capabilities needed to design and manufacture their products. This was complemented by integrating complex value chains of supplier firms. However, capital markets have pushed these large firms to be far more capital efficient. This required them to thin down to their “core competencies” and to go “asset light.” As a result, the role larger firms played in bringing best production practices to their industry, and forming workforce training systems for their supplier systems, declined. This means that our firms are now more “home alone”—their shared industrial infrastructure has thinned out.

In contrast, we looked at Germany—which has 20 percent of its workforce in manufacturing compared to our 11 percent, pays some 66 percent more in wages and benefits to its manufacturing workers compared to ours, and runs a very large trade surplus in manufactured goods (including with China), compared to our huge deficits. During the same period when the U.S. manufacturing ecosystem was thinning out, Germany worked to intensify its shared industrial infrastructure—closely connecting its small and large firms and tying them to technical institutes and a rigorous system of workforce training, with a very collaborative system. German manu-

facturing is a very different system from ours, but their success may hold some lessons for us.

(2) The Connection Between Innovation and Production

For a time, U.S. manufacturing thought we could *distribute* manufacturing—we could innovate here and produce there. And to stay strong our major firms needed to be participating in major markets abroad.

This view is perhaps best embodied in Apple, a company that no one would dispute has an exceptional track record at delivering highly innovative new products, but is able to do this without keeping its manufacturing under one roof, let alone in the same country. We found that this separation of design from manufacturing can work for firms in a sector such as consumer electronics, where there has been tremendous standardization of the production processes and development of robust digital design environments. In addition, in the case of Apple, their huge market clout allows them to form unique partnerships with suppliers that emerging companies are not able to replicate.

But in most sectors—particularly where we are producing complex, high value goods—the study found that there were very close, critical links between innovation and initial production stages. Moving from innovation to product design can take years and is highly creative—there are critical feedback loops where the innovation is reworked as the product idea emerges. If you shift production abroad, we found that in many cases innovation capability has to follow it, or the innovation process is severely slowed down.

The Gillette company provides an example of production-innovation integration. It's hard to imagine that a commodity product (*e.g.*, a disposable razor) is manufactured first on a 30-acre waterfront site in downtown Boston, just two blocks from some of the most expensive office real-estate. Why is this the case? Well, in fact, razor blades turn out to be a highly complex good—they use, among other things, nanoscale diamond-like carbon coatings deposited in high vacuum (to keep the blades sharp), laser-welded materials, custom-formulated polymers for the blade suspension, and high-precision molded parts. All of this new production capability has to come together to manufacture these parts in high volume. Differences of pennies in the manufacturing costs can translate to significant profits or losses in this multi-billion dollar market. What Gillette has learned is that they must make these products in the same location where they interact with their customers and where they design the next generation products. This linkage of production to innovative design is critical to the success of Gillette. We have also seen this in a recent study we have done at MIT on advanced biomanufacturing. For example, in one sector of biomanufacturing, we found that 80 percent of all clinical production facilities are within 100 miles of the company's R&D center.

Innovation has been the U.S. strong suit—it's what we do best. But if important parts of innovation have to follow production, we could be affecting our innovation strength. And it is innovation that is the critical factor behind growth.

(3) The Scale-Up Problem

We found that part of our problem in linking innovation and production is because we have growing difficulties in rapidly *scaling up production*.

We have many manufacturing sectors, but basically three kinds of firms—large multinationals; small and mid-size Main Street firms; and entrepreneurial, start-up firms.

Our large multinationals are global; they can cut production costs to compete by locating in lower cost and wage markets abroad, and they need to be in these markets to compete world-wide. Most of the top ten firms in revenues in the world are still U.S. firms. They face intense global competition but overall are doing well—but increasingly they produce abroad.

The majority of U.S. manufacturing is performed by some 300,000 small and mid-sized firms—what we called Main Street firms. The Main Street firms in our study had survived two tough recessions. So they had to be risk adverse, and could not finance much R&D. But we found in our 200 plus interviews that to survive they also had to be quite innovative—particularly in areas like manufacturing process and repurposing existing product lines for new markets. We found they had trouble with a particular stage—scaling up their innovations into production. With the demise of local banking in the face of national banking system models, they had real trouble obtaining financing for scale up of their innovations. Generally, the only option was to fund growth out of ongoing revenues. This slowed them down and limited their growth. In contrast, comparable competitors in Germany and China can tap external resources and are able to scale up production much more quickly. So “scale-up” is a growing issue for U.S. Main Street firms.

Scale-up is an issue, too, for our entrepreneurial and start-up firms that are commercializing innovations. We studied a group of 150 innovative firms that were able to obtain significant venture capital support. The venture support stayed in these firms beyond the 5 to 7 years we expected—it could extend 10 years or sometimes longer. But these firms faced obstacles when they reached the critical stage of product design, and asked their venture partners for funding to scale up production of their innovative new product. They were generally told that the venture firm had difficulty investing in production scale-up and were instead directed to contract manufacturers abroad or sometimes to sovereign wealth funds.

Innovation at scale is not a short-term process. Most new products cannot be replicated at near-zero marginal cost like software. Getting support for production scale-up of manufactured goods has become a significant problem for our entrepreneurs.

As an example, I'd point to a start-up firm I've had experience with: Lilliputian Systems. This is a firm that spun out of my lab at MIT in 2001. It was founded based upon research done at MIT under DARPA and Army support, as well as technology from Livermore Labs. Just this past winter, Lilliputian was finally able to demo their first product, which I have here. It burns a fuel (butane) in a completely safe way and generates electricity to recharge your mobile device when you are 'off the grid'. In fact, this product, when powered by a disposable fuel cartridge, will repeatedly recharge your mobile phone for 2–3 weeks, meaning that "pound-for-pound" it has an order of magnitude more energy than the best battery you can buy. However, it hasn't been easy to get to this point. It's taken more than 10 years (a common time frame for disruptive new products using new technologies), it's required well in excess of \$100M, and even today the company is working hard to identify investors to support the scale up of this fully functioning device to volume production.

Many of the challenges Lilliputian Systems faces are those that we hear over and over again. Namely: it takes a long time (especially if you need to rely on offshore production and development capacity) and domestic sources of capital for production infrastructure are hard to find (which encourages companies to seek foreign investment and to transfer production overseas).

Today, to get through this stage small U.S. firms increasingly do need to reach abroad. But remember the PIE study showed us clearly that in many industrial fields innovation and production need to be integrated. So unless we can solve this scale up problem, I worry that tomorrow's innovative industrial companies—built on the next generation of technology advances—may increasingly come from abroad.

The Connections Between the PIE Findings and AMP

The key findings of the PIE study link quite closely with the Advanced Manufacturing Partnership (AMP) project, the collaboration between industry and universities that Secretary Pritzker has described.

Re: Rebuilding the infrastructure—

AMP's July 2012 report recommended industry-university-state and local government collaborations in which the Federal Government would cost-share, built around "Manufacturing Institutes." These would be joint efforts to advance the development of critical new production technologies that could be transformative across multiple manufacturing sectors. They would support applied research, technology demonstrations and testbeds, and build collaborations between small and large firms and researchers. They are somewhat similar to the Fraunhofer Institutes so key to Germany's production system.

These manufacturing institutes fit with the MIT PIE recommendations on rebuilding our industrial infrastructure—they could fill a critical gap.

While the MIT PIE report found we didn't have a critical skilled workforce problem at this time, we will need new training and education if we are to shift to advanced manufacturing. If we don't have the trained talent to move into these new areas, we'll never get there. AMP recommended expanding the role of community colleges for this role. We can also apply the lessons we are learning in online education to develop new highly effective training modules for both workforce and engineer education.

Re: Linking Innovation and Production—

The network of Manufacturing Institutes, particularly through their testbed role, could also help link innovation with production.

In addition, a major step recommended by AMP is to develop collaborative industry-university-government manufacturing technology strategies. We need to look at the whole innovation system from research through production to figure out together how we can actually implement these breakthrough production technologies,

along with their related processes and business models. The Manufacturing Institutes are part of these strategies but we need to look at R&D feeding into the Institutes, and the next stages of implementation, as well.

We will need technology strategies and roadmaps to develop new production paradigms around technology advances—like digital manufacturing, additive manufacturing, mass customization, and advanced materials—to give us new efficiencies and productivity to compete with lower cost competitors.

Re: Scale-up

AMP will be looking hard in coming months at policy to fill the gap in our innovation system around the production scale-up problem.

Here again, manufacturing institutes will be an important strategy. They can help prove out the efficiency and costs of new production technologies, making it easier for smaller firms to obtain financing. But other approaches must be considered as well.

Congressional Action

I'm pleased to see that you and your colleagues are considering actions to help implement one key recommendation of the AMP report. Two of your colleagues, Senator Brown of Ohio and Senator Blunt of Missouri, have introduced legislation that would establish a Network for Manufacturing Innovation Program, built around Centers for Manufacturing Innovation much like the Institutes the AMP team envisioned. Congressman Kennedy from my own state of Massachusetts and Congressman Reed from New York have introduced a companion bill, so there is now bicameral, bipartisan momentum building behind these ideas.

Conclusion

Creating an America that will work better for ourselves, and work well for our children, will not be easy. The MIT study found that if we want to ensure that America's future is enriched by a robust manufacturing sector, as our past has been, creating better ties from our innovation system to our production system will be essential.

The Advanced Manufacturing Partnership suggested that public-private partnerships are the right model to create such ties in the U.S.—industry, colleges and universities, and local and state governments can work together to build strong industries taking advantage of regional assets and expertise. Federal programs can support regional economic development, the sharing of best practices, and the development of capabilities essential to defense and other national needs.

With the AMP effort moving into its next phase and Congress giving serious consideration to the role of manufacturing in maintaining U.S. competitiveness, we have a real opportunity to strengthen our innovation ecosystem in ways that will help rebuild our economy.

Thank you.

The CHAIRMAN. Thank you very much. It is a terrific panel.

Michael Garvey, President and CEO, M-7 Technologies in Youngstown.

**STATEMENT OF MICHAEL S. GARVEY, PRESIDENT AND CEO,
M-7 TECHNOLOGIES**

Mr. GARVEY. Thank you, Chairman Rockefeller, Ranking Member Thune. Thank you to the Committee members and staff for inviting me to testify on the use of manufacturing hubs to foster innovation.

But before I present my testimony, I would like to take a minute to tell you about myself and a little bit of my background.

I am the President and CEO of M-7 Technologies, a small manufacturing, engineering, and applied research company in Youngstown, Ohio. We currently have 35 employees. We service the manufacturing sector of the United States. I am third generation in a family business that began in 1918. We are a founding member of the National Additive Manufacturing Innovation Institute, America Makes, and currently hold a seat on their governance board.

Even though manufacturing has always been in my blood, it was not my first choice when deciding on a career. I had different aspirations. Shortly after graduating from Michigan State, I accepted a job on the trading floor of the New York Stock Exchange. About 2 years into this dream job, I got bad news. Back in Ohio, my father had been admitted into the hospital and was critically ill. Long story short, I left a promising career on Wall Street and returned home to help my parents rebuild their manufacturing business, one that had been devastated by the rapid decline of the domestic steel production. That was in 1985.

Since then, I have developed a deep appreciation for manufacturing, especially American manufacturing. It provides the weapons systems that protect our freedom and the equipment that powers our country. It is sophisticated and complex. It presents problems that require brilliant solutions. It is a very satisfying career and I encourage anyone with interest in math and science to consider it. The last 25 years, I have realized that a career in making things is more important than a career in trading things because when American makes, America works.

In 2001, my wife and I decided to transition our company to a technology-based business leveraging a skilled workforce to create a sustainable business model. This decision has since led me to work with several universities and leading research institutions. We have partnered with businesses in both the Middle East and Western Europe. We anticipate additional partnerships with firms in Southeast Asia to be finalized in quarter one of 2014 as we begin the commercialization of our technology.

Through this process, I have been exposed to both domestic and international models for innovation. The differences are very intriguing but become disturbing when studied closely. In the United States, basic research is funded by several sources, primarily government organizations. Then, typically a resource issue develops as entrepreneurs attempt to transition to commercial application. Resources in scant supply can include equipment, people, and money, or all three. As a result, tremendous amounts of valuable technology never make it to market. It is akin to leaving the baby at the door.

This does not happen in other countries, which are our global competitors. Other countries have established manufacturing hubs to address these resource issues. An example are the Fraunhofer Institutes in Germany.

The National Additive Manufacturing Innovation Institute, America Makes, is the pilot project of the proposed national Network of Manufacturing Institutes, the United States' answer to other countries' manufacturing hubs. M-7 is a full member of America Makes and pays annual dues of \$50,000 a year. Although this may sound expensive, it is not when compared to what M-7 would need to invest or to duplicate the equipment, expertise, and relationships available at America Makes. This model neutralizes the resource issue and makes the valley of death less intimidating. It allows us to focus on the real issues of creating commercially viable applications of our technology. Those commercially viable applications create jobs and provide a tax base.

In addition to member benefits such as these, the accomplishments of America Makes in the first 14 months are nothing short of remarkable. They include:

Approving membership applications for 82 organizations resulting in a total annual dues revenue stream of \$3.2 million and growing.

The creation of a national road map for additive manufacturing technology development.

Organized and active participation in the ASTM International Standards Development Committee F-42 which will ensure consistent and rapid commercial adoption of the technology as it develops.

The establishment of a national repository for all additive manufacturing technology and information through the creation of a digital estate.

The development of a curriculum platform to transition the current and future workforce to 21st century skill sets. This effort was underscored with Mr. Spiegel's donation to Youngstown State University of PLM software in the amount of \$440 million and yesterday's announcement by Maker Bot donating 5,000 3D printers to school systems across the country. This was facilitated by America Makes.

Funding the management of six projects with total value of close to \$10 million, with the anticipated initial commercial value of \$200 million. It is a 20-to-1 return on the investment and over 700 jobs created or retained.

And a planned private investment of approximately \$350 million for the creation of a SmartPark to facilitate the commercialization process of America Makes members with a customer-focused, commercially driven, proximity-based co-development environment for additive manufacturing applications.

None of these accomplishments would be possible without the creation of the National Additive Manufacturing Innovation Institute, America Makes, the pilot project of the National Network for Manufacturing Institutes, our answer to others' manufacturing hubs.

Thank you.

[The prepared statement of Mr. Garvey follows:]

PREPARED STATEMENT OF MICHAEL S. GARVEY, PRESIDENT AND CEO,
M-7 TECHNOLOGIES

Thank you Chairman Rockefeller and Ranking Member Thune. And thank you to the Committee Members and staff for inviting me to testify today on the use of manufacturing hubs to foster innovation.

But before I present my testimony, I'd like to take a minute to tell you about myself and my background.

I am the President and CEO of M-7 Technologies, a small manufacturing, engineering, and applied research company in Youngstown Ohio. We currently have 35 employees. We service the manufacturing sector of the United States. I am third generation in a family business that began in 1918. We are a founding member of The National Additive Manufacturing Innovation Institute, America Makes and currently hold a seat on their Governance Board.

Even though manufacturing is in my blood, it was not my first choice when deciding on a career. I had other ideas. Shortly after graduating from Michigan State, I accepted a job working on the trading floor of The New York Stock Exchange. About two years in to my dream job, I received some bad news. Back in Ohio, my father been admitted to the hospital and was critically ill. Long story short, I left

my firm in New York, and returned home to help my parents re-build their manufacturing business. That was in 1985.

Since then, I have grown to love manufacturing and the challenges it presents, especially when technology is introduced in the manufacturing process. And, I have realized that a career in manufacturing can be more rewarding than one on Wall Street.

So, as a result, my wife and I decided to build a technology driven manufacturing business, leveraged with a skilled workforce, to create a sustainable business model. This decision has since led me to interact with several universities and leading research institutions. We have partnered with businesses in both the Middle East and Western Europe. We anticipate additional partnerships with firms in South East Asia to be finalized in Q 1 of 2014 as we begin the commercialization of the technology we have recently developed.

Through this process, I have been exposed to both domestic and international models for innovation. The differences are very intriguing but become disturbing when studied closely. Typically, in the United States, basic research is funded by a several sources, primarily government organizations. Then, a resource problem develops when entrepreneurs attempt to commercialize their technology. The commercialization process can be very expensive and time consuming. Investors are not willing make the necessary investments without assurance that their investment will yield a return, but the entrepreneur has yet to receive an order for his technology. So, tremendous amounts of technology never make it to market. This is why they call it “the valley of death”. This does not happen in other countries, our global competitors. Other countries have established manufacturing hubs to address this issue. One typical example is the Fraunhofer Institute in Germany.

The National Additive Manufacturing Innovation Institute, America Makes is the pilot project of the proposed National Network of Manufacturing Institutes, the United States’ answer to other countries manufacturing hubs. M-7 is a lead member of America Makes and pays annual dues of \$50,000. Although this may sound expensive, but, if M-7 were to duplicate the capabilities and equipment available at America Makes, it would have to invest sustainably more to have similar assets in house. This neutralizes the resource issue and makes the valley of death less intimidating. It allows us to focus on the real issues of creating commercially viable applications of our technology. Those commercially viable applications create jobs and provide a tax base.

In addition to member benefits such as these, the accomplishments of America Makes in the last 14 months are nothing short of remarkable. These include:

- The creation of a National Roadmap for additive manufacturing technology development
- Organized and active participation in the ASTM International Standards Development Committee F-42 which will insure consistent and rapid commercial adaption of the technology as it develops
- The establishment of a national repository for all additive manufacturing technology and information through the creation of a Digital Estate
- The development of a curriculum platform to transition the current and future workforce to 21st century skill sets. This effort was underscored with yesterday’s announcement of Maker Bot donating 5,000 3-D Printers to school systems across the country. This donation was facilitated by America Makes.
- Funding and management of six projects with total value of close to \$10.0 million with anticipated initial commercial value of \$200 million, a 20-to-1 return on investment, and over 700 jobs created or retained.
- And, planned private investment of approximately \$350 million for the creation of a SmartPark to facilitate the natural progression of America Makes members with a customer focused, commercially driven, proximity based co-development environment for Additive Manufacturing applications.

None of these accomplishments would be possible without the creation of The National Additive Manufacturing Innovation Institute, America Makes, the pilot project of The National Network for Manufacturing. Our answer to others manufacturing hubs.

Thank you very much.

The CHAIRMAN. Thank you, sir. Thanks for giving your background. That is a fascinating—you being a trader on the floor and then your father gets sick and your company is in trouble. You just

pick up and go home and start out a whole other incredibly useful life. As you say, making is better than trading.

Mr. GARVEY. I realized that I would not have achieved the level of success in New York if it had not been for my parents.

The CHAIRMAN. Yes. Good son.

Dr. Brewer?

**STATEMENT OF DR. TERRY BREWER, PRESIDENT,
BREWER SCIENCE, INC.**

Dr. BREWER. Chairman Rockefeller, Ranking Member Thune, the rest of the Committee members, and distinguished guests, my name is Terry Brewer and I am President of Brewer Science, first generation in this case, an advanced technology innovator and manufacturer located in Rolla, Missouri. I appreciate the opportunity to speak today.

First of all, I also need to give you a little bit of background on Brewer Science, the company. I founded the company in 1981 and established the headquarters in Rolla, Missouri. Brewer Science is a major innovator of high technology processes and materials that are used to create most of today's ultra-small circuits that are used in most electronic devices from tabletop computers to smartphones to televisions, displays, et cetera. These circuits find their way into most of the advanced digital technology products that we all use today. You will find them in your pocket right now—most of you will, anyway—hopefully turned off as part of your cell phone. None of these devices would be possible without the technology developed and manufactured by Brewer Science. We also continue to create new levels of technology for these devices.

Historically speaking, I think our success was fostered by the U.S. Government, which played a large role in helping that success take place by creating an environment that encourages entrepreneurs to take the risk and go out into the marketplace with their new ideas and new products. A real good example that has been brought up several times today is, of course, Silicon Valley. The semiconductor industry is a great example of a group of entrepreneurs taking some risk and, with some Government support, created an entire industry that has changed the world.

I think that the driving force in this public-private partnership is really impacting the development of technology but also is impacting the economy of the United States. And I think technology innovation is really key.

The questions now are—I have heard them already today—so how does the Government continue to foster great U.S. technology business as we move forward, and also, how can we sustain and grow our global technology leadership? We have heard lots of good ideas, lots of comments and information today, which can lead us in that direction.

There are many answers, however, when it comes to how we really engage and promote our manufacturing success in the U.S.

So other than the proposed manufacturing centers, I think we have to look at other answers such as tax reform, particularly making the R&D tax credit permanent, and I think broad-based Federal regulation relief is important. I also think intellectual property law enforcement is really important. The Secretary was here today

and we have made many visits to Washington to talk about that subject not only regarding the intellectual property laws themselves but about international trade agreements, which often are made without any real teeth in their enforcement. I think these are all areas that could help U.S. business.

Regarding STEM support. We are very much in favor of, encourage this, and spent a lot of time supporting STEM.

Of course, this legislation, which really promotes advanced manufacturing centers, I think, is a great idea. We are also really supportive of this approach.

But remember there are many different ways that we can encourage improvement in our economy, our environment, and in our manufacturing competitiveness.

When you think about STEM, I think it is important to think about one thing, and that is the students will be attracted to STEM when they see clear value for themselves as an outcome. STEM itself is not really a job creator. Industry and manufacturing that use these skills are the job creators. So as valuable as STEM might be, it is only half the circle. I think this is a very important point. If you want to keep the best talent in the United States, make sure the best opportunities for them reside here. This is really, really key.

Also, I want to applaud the authors of the legislation, the bipartisan advanced manufacturing legislation, particularly Senator Blunt and Senator Brown, who were here in the beginning. They have done a very good job of constructing this legislation. One of the most powerful elements of the bill is that it does not attempt to prescribe technology or location winners. I think part of the issues in the past have been programs that are prescribed programs for technology. I think it is up to industry and business to determine where success can occur, and one of the real strong features of this bill is it does not prescribe. I think that is really key, very important.

In conclusion, I think the leaders that have constructed this legislation should be praised for their willingness to invest once again in the great U.S. manufacturing engine. I think a show of confidence and belief that this engine is still strong and will succeed is an important message to send to America, and I think this bill and your committee is doing that.

As the Commerce Committee, I am sure that you must also be aware of the importance of sending this message back to the United States. Very important.

So thank you for your interest and for allowing me to share my perspective with you. And I would really be pleased to talk further and have further discussions about this. Thank you.

[The prepared statement of Dr. Brewer follows:]

PREPARED STATEMENT OF DR. TERRY BREWER, PRESIDENT, BREWER SCIENCE, INC.

Introduction

Thank you Chairman Rockefeller, Ranking Member Thune, Committee members, and distinguished guests. My name is Terry Brewer, and I am President of Brewer Science, an advanced technology innovator and manufacturer located in Rolla, Missouri, which is located halfway between St. Louis and Springfield, Missouri. We support our customers worldwide with a service and distribution network in North America, Europe, and Asia. I appreciate the opportunity to speak with you today,

and I want you to know the support of advanced manufacturing is of great interest to me, my company, my industry, and my community.

Brewer Science History

I founded Brewer Science in 1981 and established its headquarters in Rolla, Missouri. Brewer Science is a major innovator of high-technology processes and materials used to create ultra-small circuits that enable devices such as tablet computers, smartphones, digital cameras, and flat-panel monitors and TVs. The stringent specifications of these products provide Brewer Science with opportunities to leverage the company's experience and creative capabilities to develop needed advances in technology for both government and private sectors. Our product line encompasses unique materials, processes, and equipment that are used to give devices more capability in less space for lower cost. Most microelectronic devices we rely on in our daily lives, including the smartphones you are using, would not be possible without the technology we deliver and continue to develop at Brewer Science.

Fostering Success

Historically, the Government has helped to create an environment where entrepreneurs can succeed, allowing the private sector to successfully develop emerging technologies, which lead to new products and new advanced manufacturing jobs. Public-private partnerships have also had a big impact on developing many technology-focused aspects of our economy. For example, Silicon Valley would not have become a global driving force in microelectronics development and manufacturing if not for government support. So, how can our government continue to foster great U.S. technology business development? How can we sustain and grow our global technology leadership? These important challenges can be surmounted through several approaches, including tax reform, particularly if it includes making the R&D tax credit permanent; broad-based Federal regulatory relief; long-term authorization and continued oversight of the SBIR program; enforcement of the existing intellectual property laws and international trade agreements; continued support of STEM education programs; and establishment of a select number of advanced manufacturing centers that support diverse innovations and locations throughout the United States.

Tax and Regulatory Consistency

As both an innovator and a business owner, I confront many challenges in both managing my business and innovating tomorrow's technology. One area where Congress could make a big impact is tax reform. As it stands now, the tax code is too complicated, which results in higher compliance costs for smaller businesses like mine. In addition, long-term planning is very difficult when many pieces of the tax code expire after a couple of years and have to be renewed—sometimes many months after they have expired. For example, the R&D tax credit is vital to both my company and the economy as a whole, as it encourages people to take risks and deploy capital, which is almost always limited, to new ideas. It is difficult for me to do the type of long-term planning that, ideally, I would like to do, when faced with a regular expiration of the R&D credit.

Enforcement of our intellectual property laws is also vital to the success of the American entrepreneur. I strongly encourage Congress to continue to push the regulatory agencies to enforce these protections. In a global economy, it's very easy for companies and state-backed entities abroad to steal our ideas and inventions.

Access to Innovation

Location or size of a community is no longer a necessary factor for a successful business. Brewer Science is proof of this, and we are not alone. Brewer Science could be located anywhere in the world, but I chose rural Missouri. Not everyone in the United States associates rural Missouri with advanced, high-technology manufacturing, but that is changing—and the reason is, simply, innovation. The ease of user access to technology we have in the United States is key to making our country the global innovation leader. Our strengths in workforce development, education, and community growth programs have one thing in common—innovation with freedom of location. By diversifying the location of the proposed advanced manufacturing hubs throughout the country, you are taking advantage of this innovation development strength.

Applied STEM—U.S. Advanced Manufacturing:

Much attention has been given to support of STEM-related education programs and to attract more students to the STEM fields. I also fully support these efforts. However, I would like you to consider this—students will be attracted to STEM fields when they can clearly see the value of participating in these areas. Science,

Technology, Engineering, and Mathematics do not create jobs by themselves. Industry and manufacturing that require these skills do. By supporting the creation of advanced manufacturing centers, you will be providing places for people to implement STEM. If you want to keep the best talent in the United States, make sure the best opportunities for them are located here.

Diverse Technology Solutions

There are many different approaches to fostering advanced manufacturing in the United States. I applaud the authors of the proposed bipartisan advanced manufacturing legislation, including Senator Blunt and Senator Brown. In particular, one of the powerful elements of this bill is that it does not attempt to determine technology winners. By not prescribing the specific technology solutions, you are encouraging our business and scientific minds to explore and determine the best and most needed solutions. The approach outlined in this bill leverages the experience and capabilities of our best talent, while auditing and encouraging those companies that deliver results.

Conclusion

In conclusion, the leaders that have constructed this bill should be praised for their willingness to invest in the great U.S. manufacturing engine that is so vital to our people, our communities, and our Nation. Other countries see the value of attracting the businesses and people that embrace advanced manufacturing to their locations. When our government provides the leadership and support needed to coordinate the establishment of advanced manufacturing hubs that embrace diversity in location and technology in the United States, our people, communities, and businesses will grow and provide the foundation for us to solve our next unforeseen challenges. The same confidence, intelligence, and belief in the values and principles that have built our great, great nation are demonstrated in this bill and will continue to sustain and enhance our great quality of life.

Thank you for your interest and for allowing me to share my perspectives with you. I would be pleased to discuss this further.

The CHAIRMAN. Dr. Brewer, thank you. And just let me say to each of you, your four presentations were as good as I have heard in a number of years here, all totally focused. You actually all stopped at 5 minutes, which is kind of historic, but you said everything that you wanted to say.

You made the point about STEM, Dr. Brewer. One of the problems is that people do not see the value for them at the end of STEM, but I would posit that if there is anything that is clear—and you said so yourself—there is an enormous need for them in the workplace. I mean, they have to know that.

Dr. BREWER. You know, you would hope they would know it. They have to know it? I do not think so. I think you heard some testimony last week that said for women to go into computer programming, they had to make it fun, they had to make it the most favorite course at the university. So I think that, indeed, young people are not aware that the outcome from STEM is necessarily valuable in their lives.

The CHAIRMAN. Then that is a tremendous shortfall. We are all concentrating like crazy on it.

Dr. BREWER. Yes.

The CHAIRMAN. America COMPETES, everything. I mean, laws are passed. You are all adamant about it. And somehow that has just got to reach them because we need them and we need them here.

Dr. BREWER. Yes. And I think businesses must do their part to show manufacturing today is not like it used to be. It is not the Rust Belt, and in Asia it is still done in mega-factories. But in lots of places in the United States, manufacturing is not done in mega-factories. It is done with computers, software, and technology. This

is a different world, I think a world that maybe the young people are not aware of.

The CHAIRMAN. OK.

Can I ask just one more question that interests me? Mr. Schmidt, maybe you can help me on this. MIT concluded a study on the subject of commercialization and found that innovation and manufacturing are closely linked. That would be self-evident. But then you said if we start losing one, we will lose the other as well. And then the reason that you give is very interesting to me. Many innovations take place on factory floors with incremental improvements to product design and functionality as the process moves along. And your point there, of course, is that when production moves overseas, all of that incremental improvement, as well as the knowledge, just is not available. It is a very interesting point to me. Could you just elaborate a little bit?

Dr. SCHMIDT. Yes, I would be happy to. The point really is to bring some of these products to market, you need a lot of complementary skills and assets, not the least of which is people that understand how it is going to get built. In my experience in the transfer of technologies out of our labs and in the startups we have been involved with, it always comes down to people that have been there and done that and know how to stitch together a lot of different capabilities, a lot of different knowledge for a unique product. And when you lose that, it just slows things down, if not make it impossible to do it there. And so I think as that capability—you mentioned semiconductors in your opening remarks. That is an area where much of the semiconductor infrastructure is elsewhere, and so it makes it challenging for us to develop products, derivative products, based on that core manufacturing technology. And so that is the challenge we face, is keeping some of that raw capability here so that we can innovate in the next generation product based on that manufacturing capability.

The CHAIRMAN. Thank you, sir.

I have another question, but Senator Thune.

Senator THUNE. Thank you, Mr. Chairman.

And I too want to just compliment the panel. Thank you for sharing your experience and insights. It was very helpful and a wealth of experience represented at the table today.

Dr. Brewer, in your submitted testimony, you emphasized the tax and regulatory consistency issue be at the forefront of efforts to stimulate manufacturing growth. And specifically, you advocated for the permanent extension of the R&D tax credit and enforcement of intellectual property and trade laws. Can you share examples of how the R&D tax credit uncertainty and lax enforcement of IP and trade laws have hindered your company's long-term planning and ability to profit from some of your innovations?

Dr. BREWER. Yes, that is a great question, and it does show that the problem is much more complicated than you think.

In terms of R&D tax credits, about 9 percent of that tax credit goes directly for hiring people, and if that tax credit does not show up until the end of the year or after the end of the year, like it gets retroacted in January for the year before, it means we will not hire people the credit would have supported. If we knew the tax credit was there, we could invest in the people to do the research

or do the development. So if you do it a year behind time, it is really not going to be utilized very well, at least to generate salaries for people.

In terms of the intellectual property and not having much teeth in it, I can share some data that came from the semiconductor industry. That is my industry. I am in the U.S. in the semiconductor industry, and we do successfully compete in our technology worldwide, so it is not all gloom because a lot has moved overseas.

But in that example, the semiconductor industry, in terms of material suppliers to the industry, there was a 100 percent violation of intellectual property by customers or others to the semiconductor suppliers. 100 percent. It means that every single company saw patented technology that they own get inappropriately used or borrowed or misused by other companies. And there is not much action that can be taken as a result of current laws. If you go to Asia and try to go to court, for example, in Korea, it takes years and years and years to achieve results, and it then becomes a moot point at the end of that period of time.

And so like the Korean trade agreement, which was passed a year or so ago, there were absolutely no teeth, absolutely no enforcement of intellectual property protection in the trade bill. And even though there have been efforts to add that kind of stuff to the trade bill, there is then a need to rush it through to just make something happen, and it all goes. And so we end up with, time after time, getting trade bills that put no teeth into the intellectual property enforcement. That is particularly challenging for the semiconductor industry because 60 percent of my marketplace is in Asia, and number one, two, and three in terms of the countries that violate intellectual property patents are Korea, Taiwan, and China. So no teeth in that legislation is very much a problem.

However, they did a really good job of improving trade secret protections—strengthening trade secret protection in this last intellectual property bill, and that really had a good impact for us and I think most companies in the United States. But I go up to the Hill every year and to the Commerce Department to talk about enforcement of trade issues and enforcement of intellectual property issues. And I think there is a lot of willing people but very little action has come from it.

So that takes care of those two things.

The third element that you talked about was?

Senator THUNE. Trade IP and R&D tax credits.

Dr. BREWER. OK, those two. So I think that kind of covers those areas.

Senator THUNE. Thank you.

Mr. Spiegel, can you talk a little bit about the impact of the medical device tax on your business and industry generally? I mean, we are told that it is \$30 billion and possible as many as 43,000 jobs that are impacted, and that could, obviously, lead to reduced R&D budgets as well.

Mr. SPIEGEL. Yes. There is a 2.3 percent medical device tax. We are one of the largest manufacturers of medical devices in the world. This last year can have a direct impact. It says \$30 million there. Long-term we see it more as being something like \$60 million a year. If you take a look at that as a percentage of your profit,

it takes a big cut out of your profit. And so, of course, management wants to know how are we going to make that up. The market is not growing. Right now the market is pretty flat. People are trying to figure out where the world is going with the new Affordable Care Act, and so we are not seeing a lot of growth in new medical devices and things. Maybe that will happen later.

Of course, we were counting on more people getting signed up to come on to the program, but we have not seen that yet. So the demand is kind of flat, and therefore, we have got to find other places or slow down R&D, a lot of which we do in Princeton, New Jersey. We do a lot of R&D located very close to our manufacturing plants, which we talked about here. But our biggest R&D facility and a lot of our health care R&D is done in Princeton, New Jersey. So the basic thing is you got to look for opportunities to reduce costs, reduce head count, reduce R&D. You got to find some way when you lose millions of dollars in profit.

So it is definitely having a big impact, and I know across a lot of our suppliers, it is having a big impact and also our competitors as well. So it is definitely having an impact on spending and growth.

Senator THUNE. Mr. Chairman, my time has expired. Thank you.

The CHAIRMAN. All right. Now I am presented with a quandary. Senator Booker was here before—

Senator BOOKER. Mr. Chairman, I will make it easy for you. I will yield to my more senior Senator, Mr. Blunt.

The CHAIRMAN. Do you want to yield?

Senator BOOKER. I will reserve my time and yield to the more senior Senator.

Senator THUNE. He is learning quickly, Mr. Chairman.

[Laughter.]

Senator BLUNT. He not only came and came early, but then yields time. Thank you, Senator, and welcome to the Committee. I am glad you are here and glad this is one of your first hearings. I hope it is something that we really can move forward on.

Again, Chairman, thank you for holding the hearing—you and the Ranking Member—on this bill.

Mr. Spiegel, in the medical device area, what percentage of the Siemens' market for medical devices does the United States comprise?

Mr. SPIEGEL. I think it is about 25-plus percent of our medical device market globally. It is the biggest market in the world by far.

Senator BLUNT. It is your biggest market but still 75 percent or so of your market is in other places.

Mr. SPIEGEL. Yes. I think 70–75 percent is outside the U.S.

Senator BLUNT. We hear some of the people who are even more in this market that the tax is even a bigger thing for them because it is—

Mr. SPIEGEL. Yes. If you are more U.S.-focused and, for example, you are not in Europe or in Asia in a big way, the U.S., of course, is a much bigger part.

Senator BLUNT. It has a bigger impact on what you can do and how you can do it and what your overall profit picture is.

You mentioned the R&D. A lot of your R&D was in Princeton. Because of the centers in Germany that you described, how much

work is done there that might be somewhere else if there was a competitive hub environment like we are talking about. Do you have a sense of that?

Mr. SPIEGEL. Well, it is hard to say. We spend probably \$6 billion to \$7 billion U.S. a year on R&D. We are one of the biggest spenders on R&D of any industrial company in the world, and we spend over a billion dollars in the U.S. alone.

To the point that one of the other panelists was making, if you go back to the years when we did not have as much manufacturing here—we now have 130 manufacturing facilities—we spent very little on R&D. The R&D comes with the manufacturing. So if we push for these manufacturing hubs, like the investments that you heard that we are making around the Youngstown, the National Additive Manufacturing Innovation Institute, the more of these hubs that come in the areas that we are trying to push, the more dollars we would put into it, the more investment that would come. And, of course, R&D comes natural.

One of the reasons you want to do these hubs is get suppliers, customers, research companies, the Government, schools, universities. We do a lot of research with the universities and also with the national labs. So hopefully they are going to be attracted, and they already have been I think you heard from the numbers. So it is a natural place for us to put more R&D dollars.

Senator BLUNT. Right.

And, Dr. Brewer, you mentioned that you were pleased that this was not really location-specific as some programs are. In fact, Chairman Rockefeller and I are sponsoring the extension of the New Market Tax Credit Program which does actually give benefits to low-income areas. And, Chairman, I was in Kansas City last week at a family-owned facility that had doubled its 70-year-old business in size using those new market credits, and it was in one of the areas that qualified.

But specifically, when we decided on this one, we would let the dynamics of those hubs coming together be the qualifying factor. And I know in the case of your decision to be in Rolla, I am just wondering how much impact it had that the Missouri University of Science and Technology is located there, and either formally or informally, how has that advantaged the ability of your company to attract people and compete?

Dr. BREWER. Of course, it has helped. It is a very strong engineering school and very strong in the sciences, and having access to young students, idealistic and enthusiastic and low-paid, is a very big advantage, of course.

But I think it has a lot of secondary ripples also because we work with that university, and they have people that work with other universities. And so it becomes kind of a network infrastructure value in addition to simply the location itself.

Back to the nature of the bill, it is not prescriptive. I think that is one of the genius things that you have done with this bill that you do not often see. We had a lot of success in early days with the SBR program. At that time, it was a very non-prescriptive kind of a program across a lot of agencies and it was very instrumental in us developing our products.

But in today's world, where you are located, the size of your community, even the size of your company has very little meaning to your impact back onto the economy. So size and location, which is what you used to think of as the keys to business, are a whole lot less important today. And I think that insight is built into your legislation, which I think is a great step forward.

Senator BLUNT. Well, I hope it is. And actually, I think that is a very good point about sort of what I described earlier as the breakthrough moment that we are in. The things that used to be defining, whether you can compete or not and where you are located and other things, no longer in this moment are nearly as defining as they have been in the past. Bringing the right elements together, big or small, is what matters in how you compete rather than the things that we may have thought 20 years ago were the key elements of how you compete.

Mr. Chairman, I have used my time and possibly part of Senator Booker's time up. So I will stop.

The CHAIRMAN. Thank you, Senator Blunt.

Senator Booker?

Senator BOOKER. Thank you very much.

And, gentlemen, I just want to echo. Incredible testimony. It is really an honor to be before you all not only from the research that has been done but the true contribution you all have made in helping to grow the American economy. So thank you.

Real quick, a few things. I was really impressed that all heads shook up and down when we were talking about one of the key things Government should do is create a climate of predictability when it comes to things like tax credits and research tax credits. So the alternative simplified research credit, the ASC, which is something that I believe in—making that permanent would really help you. Yes? Mr. Spiegel?

Mr. SPIEGEL. Absolutely. I think all of these, the R&D tax credit, the manufacturing investment tax credit, all of those things, if you know those things are permanent, it makes it much easier. For me, for example, my objective is to grow our U.S. business. And for me to make the case back to the parent company in Germany to invest more money here, they want to know, OK, well, what is the advantage of investing there versus other places. And if it is on again, off again, it makes it a much more difficult story.

Senator BOOKER. Let me go one step further because if I were to tell you we were to make a decision to increase that tax credit from 14 percent to, say, 20 percent, that would relate to more research being moved here and expanding jobs. Correct?

Mr. SPIEGEL. Absolutely, yes.

Senator BOOKER. Would you agree with that, obviously, Mr. Brewer?

Dr. BREWER. Yes. In fact, we rank like 27th or 30th in the world in terms of our R&D tax credit. It is embarrassingly low compared to almost everybody else. We could all move to Canada and double our R&D tax credit immediately.

Senator BOOKER. Right. And so that is something I think that is really important to talk about.

Second, Dr. Schmidt, I really appreciate what you said about, again, workforce development, something that I have seen on the

ground for 7 years as a Mayor that we really have a problem with, especially when it comes to STEM education. We are falling behind, way behind, the rest of the globe and our competitor nations in producing engineers. Even in fact, unfortunately, we have sunk dramatically in just people with BA's, not to mention in STEM subjects.

One of my colleagues who I really have a lot of respect for, Rush Holt, is working on some things for the Defense Department's smart scholarships that I think is a really creative idea.

But, Dr. Schmidt, what are some of the things that you think we should be doing as a Federal Government to really —again, we are now in a global knowledge-based economy. The strong economies of the future are those that are going to be producing those valuable natural resources we have, which is the genius of our people in science, technology, engineering, and math.

Dr. SCHMIDT. Thank you, Senator Booker. Actually you mentioned in your earlier questions, talked about some of the challenges faced by small and medium enterprises. There are a number of things that we have learned and recommendations that are embedded in the Advanced Manufacturing Partnership report but also in the study that MIT did.

But let me pick one that I think is really compelling, which is when we studied this issue, the skills gap that you referenced earlier, one of the things that comes up is for a lot of firms, it is the people that are trained at the community college level. And I will tell you this in the form of an anecdote.

We had a really exciting event at MIT a couple years ago. We had 250 people come to campus, government leaders, industry representatives, small, medium, and large, and educational institutions. We had a CEO of a precision machining firm in Nashua, New Hampshire that stood up and implored community colleges to train more workers in the kind of skills that he needed because all of his employees had gray hair and he was not sure where the next generation was going to come from. No sooner had he made that statement, than a president of a community college that was in the audience stood up and said I just had to cancel that class. This was stunning to me.

But what you realize is that these are really specialized training. And furthermore, the community college system is optimized to shorten the commute time because these people are doing things between day jobs and family responsibilities and other things and that is a fundamental conflict. And the question is how do you break that.

When we think about it and we look at some of the revolution that is occurring on our campus and other places and this use of online education, we think there is an opportunity there. So imagine a situation where these students can take what they need to learn in the book sense, they learn it online which we know can be extraordinarily effective, but then do not make them come to campus twice a week. Have them go on the weekend somewhere and get the necessary hands-on skills. And maybe it is not just at a community college, but maybe it is a local manufacturer that opens up its facilities for training purposes. So there are a lot of great ideas out there, and I think that is one of them.

Senator BOOKER. I am sorry. Mr. Spiegel, do you have something?

Mr. SPIEGEL. Yes. I just wanted to say that we have had this problem as we have built new manufacturing facilities here. We built a new, world-class gas turbine plant in Charlotte, 800 new jobs. We could not find the workers there. So we had to bring over professors from Germany. We worked with the local community college, Central Piedmont. We set up a program to train 500 or 600 people over a period of a year in what we call mechatronics so they could work in one of these modern plants.

The second thing we did was set up an apprentice program going forward because we needed a pipeline. We hire high school kids. They go to school part-time. They work in our plant part-time. We pay them to go to school. They get a 2-year college degree. They get a journeyman's certificate, and they are guaranteed a job if they pass through the course. Two things to understand about that. There is no debt. They are guaranteed a job, and the starting salary is \$55,000 a year, which was more than the average for liberal arts graduates in the State of North Carolina.

Senator BOOKER. May I ask this point and ask the Chairman for just 2 seconds?

That is the challenge I worry about, Dr. Schmidt. The average manufacturers are not your size. The average manufacturers in the United States employ 36 people. The average manufacturers in my State employ 14 people. And so the solutions you can bring about because of the scale of your company cannot be brought about by these small manufacturers that are the average manufacturers in the United States.

So if I can beg the Committee's generosity, could you just address that for me? How do we solve that problem because of the small manufacturers that are really the bulk of manufacturing in the United States?

Mr. GARVEY. Senator Booker, so M-7 Technologies has a tuition reimbursement plan for all employees in the company. And the way the program goes is anybody who gets an A, they get a 100 percent reimbursement. Anybody who gets a B, they get about a 75 percent reimbursement; a C, 50 percent reimbursement. Anything below that, we do not reimburse. So this program is open to everyone. And we have had employees go all the way from associates degrees. They are now studying their masters in industrial engineering. So that is just one way that small manufacturers can help the skill shortage.

Senator BOOKER. Yes, sir?

Dr. BREWER. Is it OK if I can respond?

Senator BOOKER. Dr. Brewer, please.

Dr. BREWER. Oh, OK. Thank you.

You know, it is an interesting question, but I guess I disagree that small business cannot do something or play a role. We do. We bring in 50 to 60 summer interns every year from college and some from high school, from all over, mostly of course Missouri, but outside also. We also do it in all of our offices around the world, so Hong Kong, Shanghai. We bring people in and we give them jobs that are meaningful for the summer. They really have a problem that they have to solve. And so they come back for the summer.

Some of them stay over during the year, work a few hours, particularly people that need to work to support their education. They come back again next summer, and by 2 to 3 years, we have people that are trained and we have people that have the skill set we need. And we also know who are the best performers. They get tutoring and get involved in leadership and management training programs while they are with us at the same time. So basically we grow our own, and it works really well.

Senator BOOKER. The Chairman almost pitched a perfect game and I just messed it up by going over time. Sorry, sir.

The CHAIRMAN. You did, indeed. But a perfect game speaks for itself.

I would like to close with a question and a hope, a responsibility that I think you all have. They are not represented here, but there are a lot of people in the Senate who think that by definition anything that the Government gets involved in is somehow going to get skewered or abused or corrupted or whatever. And that has not been the testimony that you have given, and I would like you to affirm why you do not fall under that category. I cannot assume all of you are liberal Democrats.

[Laughter.]

Mr. SPIEGEL. Maybe I can take that on first.

First of all, I just think the evidence is out there that we are falling behind. We are falling behind in these areas of manufacturing. We mentioned advanced manufacturing. We are falling behind in skills. Our infrastructure is falling way behind. And it is pretty clear that the marketplace itself is not going to solve this problem. Again, some of it requires pretty significant investments.

But more importantly, these things really need to bring a lot of different people together if you really want to scale these. There are lots of good examples of one-off things and islands that are growing. But if you bring the people together, the Youngstown example you mentioned where we now have 80–90 companies involved there. You have universities. You have research companies. You have manufacturers, big and small. That is how you are going to scale this thing. That is what has worked in Germany and other places. Everyone off doing this on their own, letting the free market work is not going to get us there. And by the way, even if it did, it is going to take a hell of a long time.

And so I think that is why this thing can jump start this thing and get it scaled quickly. And we do need to let the market decide what are the right technologies and locations. I think letting that happen naturally I think will help this thing grow even faster.

The CHAIRMAN. And the Government sort of coming in at the beginning, and it being Government, academia, and private sector, there is nothing that says the Government is going to pick winners and losers.

Mr. SPIEGEL. No, absolutely not.

The CHAIRMAN. Dr. Schmidt?

Dr. SCHMIDT. I think Mr. Spiegel summed it very well. So I would just say I think we have a tremendous opportunity to accelerate our innovation, and it is going to take coordinated action and everybody has a role to play in that. I think what is laid out in this bill I think is very spot-on in terms of accomplishing that.

The CHAIRMAN. Mr. Garvey?

Mr. GARVEY. Well, unfortunately, we are made to pay for the sins of those that came before us that were possibly unscrupulous or whatever that abused some of the Government funding, and that is not always the case. There are good people out there and we can man these centers and we will man these centers, and we will make America great again.

The CHAIRMAN. And you put in \$50,000.

Mr. GARVEY. Pardon me?

The CHAIRMAN. You put in a lot of money.

Mr. GARVEY. We put in \$50,000 a year.

The CHAIRMAN. Dr. Brewer?

Dr. BREWER. Yes. I think whether we like it or not, the design of the United States always has married business and Government at the hip someplace. And I think it is not a question of should they be involved or not, but how they are involved. I think the cleverness and also the design of how the Government and industry work together is what is key. And that has got to change because the world is changing right now. The connection cannot go away. It is not an issue of should the Government be involved or not. Of course, it is because it always has been. It is the design of our society.

But I think we have got to continue to challenge, both of us—business and Government. We need to continually challenge each other and say, okay, the world is changing every day now. What is the right way to address that? To make assumptions like, well, let's take a big pot of money and go over here and throw it on rocket ships or something, you know, maybe that was right at one time, but maybe it is not right today.

So I think your program that does not try to prescribe, that does not try to give us the answers—you guys should be asking us the questions. Ask business the questions and let us try to find the answers. Sometimes we will do it successfully; sometimes we will not. But to prescribe the answer is going down the primrose path in the wrong direction.

Business and industry will always work together. There is no such thing that it is not. I think it is how it works together and what does the model look like. And again, what are the questions that you are asking and we need to be able to solve?

The CHAIRMAN. One of the problems we are facing in cybersecurity is should the Government be involved in helping with standards. And I have not found really anybody who can figure out a way to do what the National Institute of Science and Technology does in terms of a gold standard for what works and what does not work. It does not make it preemptive, but it makes it very helpful.

I will close with this, and then I noticed a presence on my right.

I think you have a responsibility as a business community as never before to get rid of this monkey business in Washington, D.C. and in our Congress, that the only thing that you can do to help America is to make Government smaller and to keep the sequestration right in place which will undermine at flat levels all levels of activity. And we will think about NIH and NSF and NIST and other things of that sort and then we will also think of food stamps and kids starving because they cannot get food under the SNAP

program, et cetera. It is a riveting ideological ruination as far as I am concerned.

And I think that the business community has an obligation to bomb us out of that, just as you have been helpful to us in the cybersecurity question. You were not at first. The U.S. Chamber of Commerce really sort of ruined the whole thing. The Business Roundtable did not. The U.S. Chamber of Commerce changed its view, and now I think there is more hope toward cybersecurity, which is important to all of us and all of you in many ways.

You see, if the budget keeps getting smaller, somehow we will be forced to get smarter. I cannot think of a lot of examples over history where that has worked. And if the Government is a part of the Youngstown experience, then you want to make sure that it continues to be a part of it as it expands to 45 other places. But it does mean that you have a responsibility to get us out of our ideological frenzies, which are absolutely frustrating and are preventing us—we are now, I think, at 9 percent popularity, which is a lot better than the 8 percent that we were at.

[Laughter.]

The CHAIRMAN. But part of the reason is we are not doing anything. And part of the reason is we do not contemplate doing anything, and a lot of the energy in this Congress is toward making sure that we do not do anything. That is the way you punish the President. That is the reason that you get a message that everybody repeats time after time, don't have any new revenue.

I mean, you are worrying about Obamacare. I think that is the last of your worries. That is going to work. That is going to work. It is an inevitability. The rollout and numbers of people who have signed up is the least of the measures that you have to worry about. The future of the Affordable Care Act is a very, very good one. It is going to have an enormous effect on our economy and the number of people working. And stability will be there for you, Mr. Spiegel, I promise you.

Do you agree basically with what I am saying, that if you just say we spend less money and somehow we will be a better country really does not help? Because that is where we are.

Dr. BREWER. Well, can I respond?

The CHAIRMAN. Yes.

Dr. BREWER. Perhaps it is a little bit risky. But let me look at it from another standpoint.

Brewer Science started as a bootstrap operation. We did not have any money. A lot of the reasons we were successful is because we did not have money and we had to work hard and be clever and do things that other people did not do to be a success. Now, literally we started with nothing. You know, I lived in an RV, and 31 years later, the majority of the world is using our technology to build microelectronic devices.

So from my standpoint, money is not the solution or the answer. It is not even necessary to be the solution or the answer. I know that makes it a difficult challenge. I understand that.

But lots of times I have seen a lot of companies go out of business that have been supported by venture capitalists. We are not. Venture capitalists dump in the money. They spend it quick, fast, and not very well, and the companies are gone. They want quick

solutions and quick returns. I think that is the danger of seeing money at the center of any solution.

The CHAIRMAN. I am over my time, but I am not making money the center point. I am making participation, thrust, momentum my center point. I mean, you were talking about STEM people not seeing a future for themselves, and so they do not take it seriously. Well, what in heaven's name do you think is happening at the National Science Foundation? When the Government was shut down, 99 percent of their people were furloughed. Most of them have not recovered and a lot of them have lost any sense of a stable future and are leaving and going elsewhere. And I understand that. Three weeks of a shutdown produces disastrous effects. That is the mentality that some of our colleagues here are in.

And I am just saying at some point you can—you know, they had this horrible thing in the Philippines and we had to send over aircraft carriers and all kinds of help and all kinds of things. I mean, the world does not stay still, and there are lots of problems out there and we have got to solve them. And having revenue means something. That is all I am simply trying to say. And, Dr. Brewer, you have responded to me and I appreciate that.

I call now to conclude the questions on Senator Markey.

Senator MARKEY. Thank you, Mr. Chairman, very much.

Mr. Spiegel, let's talk about wind power. Let's talk about what you are doing at Cape Wind. Let's talk about the kind of common perception, well, you know, renewables—they are nice but they are not the answer. This year, 12,000 new megawatts of wind, 3,000 new megawatts of solar. Incredible. Why do you not talk a little bit about what innovation means and how a little bit of governmental support on the price and the conditions under which you are able at Siemens to innovate off our shoreline means in terms of your investment but what it could mean for America in terms of taking leadership in wind off our shores?

Mr. SPIEGEL. Maybe just talk about wind generally and then I can talk offshore for a second.

The wind business—we acquired a small company in Denmark about 7 or 8 years ago for a couple hundred million dollars. We now have something around a \$20 billion backlog around the globe. About \$13 billion of that is offshore wind, of which we have never had an offshore project here in the U.S.

If you take a look in the U.S. in the years when there is a production tax credit, a lot of wind gets developed. In years when there is not, it does not get developed.

Now, we have also brought the cost down tremendously, about 40 percent in the last 5 or 6 years. In many of the projects we do now in the U.S. onshore, wind is competitive now with other technologies in those regions, especially if you get into a region with high wind. High wind regions where you get consistent wind blowing, is very competitive in some areas of Texas and other places. So it is getting more and more competitive. If gas does not stay at \$3 for a long time, if it goes back up to \$5 or \$6, a lot more of this wind is going to be competitive.

We are doing the same thing with the offshore wind site where we have a huge backlog, a lot of it being built over in Europe in the North Sea and the North Slope. So we are pushing that. Of

course, we are hoping that a major project is built here in Massachusetts, the Cape Wind. And it has been, I think, 9 years in the planning here. So here we are 9 years in. A lot of money has been spent by a lot of people to get this thing through the gate, and other countries around the world—

Senator MARKEY. What could it mean, though, precedentially if we do successfully construct something—

Mr. SPIEGEL. Yes, well, I think it will be a landmark project. And I know from talking to Governors up and down the coast, including New Jersey, for example, I know there is a lot of excitement about offshore wind. There is a huge amount of opportunity off the Atlantic coast. Again, we know we have got to keep working to bring the cost down, but again, the idea of starting off with a production tax credit to help this thing, if that can be kept in place for a few more years, I think we are going to be close to parity in many places.

Senator MARKEY. I agree with you. It is happening. And it is still not understood. Conventional wisdom is still, oh, that is kind of exotic. That can never really play a big role. But we know it can be 25 percent of all electricity, wind and solar and other renewables, within the next 10 years.

Mr. SPIEGEL. Yes, wind and solar and batteries. All these things are interesting because they were originally developed in the U.S. years and years ago, a lot of them, by some of the national labs and things. And then we kind of dropped the ball on them, and other countries picked it up, innovated them, drove them, and now they are bringing them back to the U.S. And we keep talking about wanting to take and develop and innovate technologies and build them into big export markets. Well, you are not going to do that unless you take the time to innovate it and develop it. And that is something these innovation hubs, I think the manufacturing hubs we are talking about—

Senator MARKEY. Where did the fracking technology come from? DOE investment. Where did the Internet come from? Federal investment in DARPA. And where do a lot of these new cutting-edge technologies that the private sector does not want to invest in come from? It is the Federal investment in the basic research that kind of sets the environment where young people say they want to move.

Over at MIT, Dr. Schmidt, there are 2,000 kids who have joined the Energy Club at MIT. So they are saying, put me in, coach. I am ready to go. But can you please create the environment where I do not have to work over in fossil fuels? I want to work in the technology sector that allows me to really make a difference in inventing a new way that we are going to be producing energy in the 21st century.

And that is not to put down fossil fuels because there are ways of actually developing new technologies that can actually capture carbon, that can make traditional fossil fuels consistent with our goals of making this a cleaner and safer planet.

So can you just talk a little bit, Dr. Schmidt, about what role, kind of some Government investment can make in new technological processes that reduce cost and make it easier to gain entry into a marketplace that can be prohibitively difficult, especially in the energy sector?

Dr. SCHMIDT. Sure, I would be happy to do that, Senator Markey. First of all, obviously, the R&D investments that feed the basic research are incredibly important to all of this. But then I think as we move out—you know, I think we talked about wind energy. I think it is a very interesting example, the fact that the State of Massachusetts has a wind turbine blade testing facility. That is a very interesting example because that is a capability that any firm that is going to develop these blades needs, but it is something that may be beyond their ability to attract the capital to create. And the fact that they can go to Massachusetts and test these, they are going to set up shop there, they are going to build that ecosystem that I talked about earlier. So I think these sort of infrastructure investments are incredibly enabling.

And the hubs that we talked about, the manufacturing innovation institutes that we talked about in this session, I think are another really important example. They fill in that gap where universities, research labs cannot go and where it is too risky for individual actors to pick up a technology and put it into production. These innovation institutes I think are going to fill that gap, allow us to advance these technologies, and actually let everybody participate, small and medium enterprises, large firms, startups. And I think they are also going to be great incubators for training and workforce development in those sectors.

Senator MARKEY. I agree with you. You know, the same wind that drove the pilgrims to our shores in Massachusetts is the same wind that we can now capture to innovate in the wind area. And with Siemens, we are doing that, and I think it is going to be breakthrough program not just for Massachusetts, but for the whole country and the world when this is successfully mounted. But it needs some governmental help in terms of create the precedent that then will create tens of thousands more jobs all across our country, all along the coastlines of our country.

And for me, that is really what this is—it has to be all about that because otherwise we are going to lose to Germany. We are going to lose to China. They have a business plan in China. We do not have to fear them, but we should respect them. They do have a plan. They want to be number one in all of these areas. But they are behind us, and a lot of what they are doing is using our own technology against us. The basic research we actually invested in but we did not create the bridge then toward manufacturing, towards actual production and job creation. So without that plan, which these other countries are putting in place, our workers will be the losers, and I think that will be the real tragedy of this whole story.

It is all there. We need a business plan for America for the 21st century, and you have laid it out for us. And I thank you very much.

And I thank you, Mr. Chairman, for having this very important panel.

The CHAIRMAN. It has been a good hearing.

Actually there is something I really want to say but I promised that I would not, so I will not. No, I will.

[Laughter.]

The CHAIRMAN. Mr. Spiegel, you said that—I am just going off his time here. You said that it would be great to see the industrial tax credit, various tax credits, R&D tax credits made permanent. I am on the Finance Committee. I have been there for 26 years, and we have talked about doing that often and we never do it. So we do it year by year by year by year. Why? Lack of revenue.

I am going to give you an example, which is going to be infinitesimally and amazingly boring but instructive, if you listen closely.

We have something called the SGR problem, the sustainable growth problem. That is called the doc fix. How are we going to pay doctors so that they will stay in Medicare and Medicaid and the rest of it? And nobody can come up with a way to do it. There is a very simple way of doing it. If we completely, for a 10-year period, make the doc fix, the sustainable growth rate, it will cost \$138 billion over a 10-year period. Now, there is a way to do that, which gets back to a point that you made earlier about if you do not get credits, it eats away at the bottom line.

This had to do with the pharmaceutical industry. There is something called dual eligibles. Those are people who are so poor they are on Medicaid and so old that they are on Medicare. They all used to be paid for by Medicaid. And back in 1993, I was in a conference committee over in the House with Waxman and Stark and a whole bunch of people, and we said that the pharmaceutical companies under Medicaid, which is a huge program, would accept lower payment because we had a bulk product to offer them. And they just could not say, well, what product do we want because they would not get the bulk product. So they had rebates. Costs were lower.

Then when we did something called Medicare Part D—I am sorry about all this language—we shifted all of those 9 million fragile, old people and their incredible costs from Medicaid to Medicare. In so doing, we did not continue the rebate, the lower costs, which was incredibly foolish on our part.

Now, if we were to do that in the Finance Committee, which I have been trying to get done, we would get \$141.2 billion and pay off all the doc fix for the next 10 years. All right? But the answer—and this gets back to what you said, no, we cannot do that because it will clobber our R&D money and we will have to spend less, and it will hit our bottom line. We did a lot of research on that, and we found that the pharmacy companies handling Medicaid with a rebate had just as active an R&D program as when they had lost their rebate and therefore had much more money to spend. No more money went into R&D in the pharmaceutical companies. No more money went into R&D.

Do you see the point I am making? It is that you cannot just get consistency, belief in the future, a sense of constancy without a plan to do it. And if you want an R&D tax credit, Corey and Jay and Ed are all for it. We are going to have to pay for it, which is the whole question of revenue. Please think about that.

And you have been an absolutely fabulous group of four people. And this hearing is adjourned.

[Whereupon, at 5:20 p.m., the hearing was adjourned.]

A P P E N D I X

INFINERA

Annapolis Junction, MD, November 18, 2013

I am writing this letter of support on behalf of Infinera, a U.S.-based supplier of Telecommunications systems. Thank you Chairman Rockefeller, Ranking Member Thune and members of the Committee for this opportunity to give input to the Committee on Commerce, Science, and Transportation as part of the hearing on “The Role of Manufacturing Hubs in a 21st Century Innovation Economy” on November 13, 2013.

Infinera is a leader in Intelligent Transport Networks. Intelligent Transport Networks help carriers respond to the increasing demand for cloud-based services and data center connectivity as they advance into the Terabit Era. Infinera uses semiconductor technology to deliver large scale Photonic Integrated Circuits (PICs) and the applications of PICs to vertically integrated optical networking solutions that deliver the industry’s 500 Gb/s FlexCoherent super-channels. The solutions offer network operators a simple, scalable and efficient option that deploys quickly, reduces operational costs and helps increase long-term revenue growth.

The demand for these solutions comes from the growth in bandwidth needs. Examples include Netflix streaming, iTunes downloads, YouTube viewing, Google searches, stock trades, FAA flight plan data, and even mobile phone traffic, which are all transmitted over optics-based equipment and fiber. Over many years, achievements in optics, electronics, and optical systems engineering have increased performance and reduced communications costs.

Despite impressive technical advances that have fueled the exponential growth in data traffic, companies are seeking innovative new solutions to meet the continuing growth in demand. Simultaneous improvements are needed in data rate, power consumption, and cost. Without these improvements, demand will outstrip capacity, which may lead to higher costs and possibly even constraints on the greater U.S. economy.

A key manufacturing challenge in this particular industry is the high cost of fabrication and assembly of integrated photonic circuits. This emerging technology is used by Infinera for long haul telecommunication networks, and will be a key enabling technology in communications and other important industries well into the future. However, as you have heard from previous testimony, commercializing new products remains expensive, restricting its commercialization and adoption. One solution would be major investments in new photonics integrated circuit (PIC) domestic commercial-grade fabrication facilities. Founded as an industry and government partnership, the PIC facility would enable U.S. suppliers to explore new photonics circuit designs and translate into commercial components.

This and other solutions to lower the barriers to commercialization will increase the ability of the U.S. to regain leadership in the communications industry. In addition, it will help secure the supply of optical components for national security and other needs, plus create jobs and strengthen U.S. innovation and manufacturing in spinoff applications.

Infinera is one of the many significant U.S.-based companies that is supporting the National Photonics Initiative (NPI), along with five leading scientific and engineering societies. Our goal is to partner with funding agencies and explore private sector support for these proposed solutions. It’s critical that the U.S. Government work with U.S. industry to resolve the “the valley of death” challenge to keep this important telecommunications industry within the US.

Thank you for providing this opportunity for Infinera to voice to the Senate Committee on Commerce, Science, and Transportation on current and future technical challenges in the United States.

Sincerely,

DR. STEPHEN GRUBB,
Infinera Fellow.

Thank you Chairman Rockefeller for organizing the hearing on “The Role of Manufacturing Hubs in a 21st Century Innovation Economy” on November 13, 2013. We at Finisar are convinced that effective collaboration between the U.S. Government and industry is vital to foster innovation and strengthen the photonics sector in the United States, particularly in our industry of telecommunication and information technology (IT).

The IT and telecom industry is estimated to be a \$4.7 trillion global market accounting for about 6 percent of the total world GDP.¹ Today, approximately 2.5 billion people use the Internet to help them in their daily lives. U.S. based companies such as Google, Amazon, Facebook, Twitter, Yahoo, Microsoft, and Apple are businesses that are critically reliant on the telecommunications infrastructure. These U.S. companies have a total market capitalization of approximately \$1.5 trillion and supply over 300,000 jobs.

Finisar Corporation (NASDAQ: FNSR) is the world’s largest supplier of fiber optic components. We are a global technology leader for fiber optic subsystems and components that enable high-speed voice, video and data communications for telecommunications, networking, storage, wireless, and cable TV applications. For 25 years, Finisar has provided critical optics technologies to system manufacturers to meet the increasing demands for network bandwidth. And indeed, the demand for network bandwidth is growing at the remarkable rate of 60 percent per year, which means that within a decade the telecommunications industry will need to expand the Internet bandwidth and data handling capacity by a factor of 100. To date, U.S. companies have been leaders in supplying the key technologies and innovations, which support the current telecommunications/internet infrastructure. However, we feel it is important for the U.S. Government to make this a national priority and to take concrete actions to preserve this critical technology and know-how within the United States of America.

Historically, the transmission of digital data occurred over copper wire but over the past few decades, due to the ever-increasing volume of transmitted data, transmission now primarily occurs using light transmitted over fiber optic cables. Expanding the transmission of data using light (*i.e.*, photons) over fiber cables instead of electrons over copper wire has provided the needed increased bandwidth to match the demand for transferring ever-increasing amounts of data.

Currently, much of this transmitted data is directed through data centers. One of the major innovation challenges for the telecommunication industry is increasing the deployment of optical technology for data transfer within these massive data centers. Presently, these data centers each incorporate tens of thousands of fiber optical cables and as many as 100,000 lasers. The next generation of improved optical data interconnects will help provide the 100 fold increase in capacity required over the next decade as well as achieve major increases in energy efficiency. Today, the IT sector uses roughly 7 percent of the worldwide electrical power, and this percentage is expected to grow substantially over the next decade, making improvements in the energy efficiency of data centers a primary goal.

The most critical component in optical communication is the laser, which generates the light that carries the signals. Finisar has laser manufacturing facilities in the U.S. (in Texas and California) and in Europe (in Sweden). Some of our competitors have moved their laser fabrication facilities out of the U.S. to Asia to reduce cost. We believe it is important for the United States to retain manufacturing capability for these critical components and believe the U.S. should work to retain these important facilities in the country.

Historically, much research for the photonics industry was conducted at AT&T Bell Labs, Nortel, and other large telecommunications companies at their in-house labs. Over time, those companies focused more on software, and many of them dismantled to a large extent their large research brain-trusts. All this knowledge and expertise is now spread out, from start-ups to universities to industry to government labs. As venture capital spending in photonics and telecommunications has declined, and as government investment in this space has declined, the burden of financing the next generation of photonics research has largely fallen on a few publicly traded companies. As the world’s largest optical component supplier, Finisar has one of the largest research and development budgets. However, with fierce competition both within the U.S. and abroad, and exploding bandwidth that requires tremendous research efforts and hence costs to meet, Finisar has to pick and choose what research to fund. We believe that higher level of U.S. investment in research and advanced development in photonics is critical for the U.S., and should be targeted at products

in the next 3–10 years, funding publicly traded companies as well as universities and SBIR/start-ups.

Finally, we believe it is critical for the U.S. to value and retain these high technology photonics research and development (R&D) jobs. Companies are increasingly moving knowledge worker R&D jobs offshore to decrease costs, which is their fiduciary duty to their shareholders. In addition, other countries are actively wooing our new photonics technologies and R&D jobs with research grants. We believe the U.S. should value this technology and work to retain these skilled R&D jobs to retain U.S. leadership in the photonics component industry.

To this end, Finisar is supporting the National Photonics Initiatives, along with five leading scientific societies and a number of major U.S. companies.³ We feel that the U.S. Government could help to ensure that this critical technology is vibrant and that key technology, manufacturing, and high skilled R&D jobs are retained in the U.S.

Thank you for providing this opportunity to Finisar to endorse the goals of the Senate Committee on Commerce and to encourage the U.S. Government to work in concert with U.S. industry to maintain U.S. leadership in the strategically important information technology and telecommunication industry.

Sincerely,

JULIE SHERIDAN ENG, PH.D.,
Senior Vice President, Transceiver Engineering,
 Finisar Corporation.

¹Telecommunications Industry Association, ICT Market Review and Forecast, 2012.

²*Optics and Photonics* Essential Technologies for Our Nation, http://www.nap.edu/catalog.php?record_id=13491

³The National Photonics Initiative, www.lightourfuture.org

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. AMY KLOBUCHAR TO
 HON. PENNY PRITZKER

Question. Secretary Pritzker, as members of the President’s Export Council you and I have heard from many companies about how we can do more to encourage and boost U.S. exports to move our economy forward. How do you specifically see these manufacturing hubs helping the U.S. increase exports?

Answer. The National Network of Manufacturing Innovations (NNMI) is widely supported by companies, large and small, that believe a stronger manufacturing innovation infrastructure will promote competitiveness in new products manufactured in the United States for export to other countries. By strengthening our ability to competitively scale-up innovative technologies by developing the necessary manufacturing processes in the United States, U.S. manufacturers will accelerate development of new high-value products. The United States will then be in a stronger position to innovate the next generations of emerging products, and manufacture those products domestically, further facilitating the export of goods.

One example of the effectiveness of such “Institutes for Manufacturing Innovation” is SEMATECH. In the 1980s, the U.S. semiconductor industry was in danger of collapse, with much of the industry moving overseas. With an infusion of \$500M of matching funds, the Defense Advanced Research Projects Agency (DARPA) helped stand up SEMATECH, a central research facility where U.S. semiconductor companies worked together to develop manufacturing processes that accelerated the scale up of computer chips from laboratory to mass production. By 2010, according to the U.S. National Science Foundation, the United States exported more than \$49 billion in semiconductors and semiconductor-dependent goods and ran a trade surplus of over \$17 billion in the sector.

The United States is the envy of the world in basic research and invention, with the help of substantial Federal support. The NNMI facilitates the transition of inventions to products by expediting the development of new manufacturing processes to scale up the production of these goods domestically. Without a stronger U.S. “industrial commons”, it would be too risky and expensive for many companies to scale-up production in the United States, especially medium- and small-size enterprises that are directed by private investors to reduce risk by scaling up overseas. By strengthening the competitive position of U.S. firms, the NNMI will enhance the ability of these companies to compete globally and expand exports.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. ROGER F. WICKER TO
HON. PENNY PRITZKER

Question. I, along with several businesses and universities in my home state of Mississippi, have been following with interest the plans for the National Network for Manufacturing Innovation. Can you briefly outline the site selection process and highlight the procedures and mechanisms in place to ensure the process is impartial and gives meritorious proposals from all regions of the country a fair and equal chance to participate?

Answer. Thank you for your question. In the context of the NNMI proposed under current authorization bills, a detailed site selection process has not yet been defined. However, our intention is to run a full and open competition with external peer review, where the NNMI is industry-led. We look to empower U.S. industries to identify where their comparative advantage lies and where the need is greatest to collaborate in manufacturing innovation institutes. The overarching goal is the development of innovation ecosystems supporting manufacturing, which is best accomplished by seeking meritorious proposals from all regions of the country.

We envision that the program will promote the competition broadly and solicit proposals from all parts of the U.S., holding Proposer Conferences and providing other support to potential proposers to maximize the submission of competitive proposals for NNMI Institutes. Evaluation criteria would include:

- Potential to advance domestic manufacturing by development and scale-up of transformational technologies, which will, in turn, have national impact on economic competitiveness.
- Commitment of continued financial support, advice, participation, and other contributions from non-Federal sources—especially from Industry—to provide leverage and resources to promote stability and sustainability.
- Engagement with small and medium-sized manufacturing enterprises, to improve the capacity of such enterprises to commercialize new processes and technologies.
- Incorporation of education and workforce development plans meeting U.S. industry needs for that topic.
- Engagement of regional organizations, assets and talent to maximize the potential of an existing—or creation of a wholly new—manufacturing hub, which would have national impact.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. AMY KLOBUCHAR TO
ERIC A. SPIEGEL

Question. As an AMP 2.0 steering committee member yourself, how do other countries' manufacturing hubs give a leg up to our competitors?

Answer. Senator Klobuchar, I'm happy to serve on the AMP 2.0 steering committee. Along with Dr. Annette Parker at South Central College in your state, I serve as co-chair of the Workforce Development Committee. Our committee has made significant progress in identifying best practices to promote, including the development of manufacturing hubs as one way to address the skills gap component of workforce development. At the Youngstown hub, community colleges and universities work with industry to develop curriculum needed to address the technology education gaps. One country model that I commend to you is Germany's Fraunhofer Institutes. Germany has over 50 of these institutes. The institutes work in different regions of Germany, with industry, the Federal and state government, and universities working to build the curriculum, identify the appropriate industry focus, and provide resources collectively to spark innovations that can be commercialized.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. AMY KLOBUCHAR TO
DR. TERRY BREWER

Question. Dr. Brewer, I have visited many companies like yours on my Made in Minnesota tour. Companies who could be located anywhere but chose to operate in and export from rural Minnesota. How can the concept of manufacturing hubs help rural economies and manufacturers continue to thrive and become even more competitive?

Answer. Senator, thank you for that question. More than 30 years ago, I founded Brewer Science in a predominantly rural area and I must tell you, many people are surprised that we have continued to thrive and grow in rural Missouri. However,

if you take another look, it's not that surprising. Technology has and will continue to connect us more and more, which makes business location less and less relevant. For this reason, we can then focus on the quality of life for our employees. In Rolla, Missouri, where our main facility is located, we have access to many activities, experiences and open space not readily available to those in other locations. These advantages allow us to foster a productive environment that promotes creativity, exploration and focus—which benefits our employees, their families and Brewer Science.

With respect to the Brown-Blunt bill, I believe that rural areas will have outstanding opportunities to thrive under this measure. I know of a number of research universities that are located in rural areas; the partnership this legislation encourages between academia and industry will create new employment opportunities for workers and the next generation of graduates to stay and grow in these communities, triggering more economic development and helping them prosper.

Attracting top talent for high-tech manufacturing jobs continues to be a challenge and I believe companies in rural locations have a distinct advantage because of the excellent quality of life that these communities can provide.

