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Statement to

The U.S. Senate Committee on Commerce, Science and Transportation

Hearing on

Leveraging the U.S. Science and Technology Enterprise

May 11, 2016

Chairman Thune, Ranking Member Nelson, and Members of the Committee: Thank you for inviting me to speak here today about the federal government's role in supporting research. I am Corporate Vice President of Microsoft Research, head of Microsoft's basic research laboratories worldwide. From 2007 to 2010, I was Assistant Director of the Computer and Information Science and Engineering Directorate at the National Science Foundation. I served twice as Head of the Department of Computer Science at Carnegie Mellon University, and was the President's Professor of Computer Science. I am currently an adjunct faculty member at Carnegie Mellon University. Prior to CMU, I served on the faculty at the University of Southern California for two years. As a student, I worked at Bell Laboratories and at Xerox Palo Alto Research Centers (PARC). I am currently Chair of the DARPA Information Science and Technology study group and Chair of the Information, Computing, and Communication Section of the American Association for the Advancement of Science. My comments today will reflect the diversity of my experiences in many sectors of the research system. Indeed, the recommendations from the American Academy of Arts and Sciences report that I will be discussing have found broad support in all of these sectors, from academia to government to industry.

I appear here today to discuss the American Academy of Arts and Sciences report, *Restoring the Foundation: The Vital Role of Research in Preserving the American Dream*. The American Academy of Arts and Sciences was founded in 1780 by John Adams and other scholar-patriots to foster dialogue among leaders of science, the arts, business and public affairs. Today, the American Academy remains an independent policy research institute, applying cutting-edge scholarship to find solutions to critical societal problems.

I had the privilege to serve on the American Academy's committee that produced the *Restoring the Foundation* report. This committee was co-chaired by former Lockheed Martin Chairman and CEO, Norman Augustine, and former National Science Foundation Director, Neal Lane, now of Rice University. Our study group was tasked with evaluating how to ensure the long-term sustainability of the U.S. science and engineering research enterprise. Neal Lane had the opportunity to testify before this Senate committee in July 2014 in advance of the report's publication. He spoke broadly about the state of the U.S. research enterprise and alluded to many of the recommendations that were published by the American Academy two months later. These

policy recommendations have found support on both sides of the aisle. I would especially like to thank Senators Thune, Nelson, Gardner, and Peters for their leadership in convening numerous roundtables with the research community to explore productive steps we can take together. Our report committee has been encouraged by the tone of these conversations, and I am grateful for the opportunity to tell you more about the conclusions and recommendations from *Restoring the Foundation*. While the testimony I will present to you today generally adheres to the committee's conclusions, the remarks represent my own views and not necessarily those of the study group, the American Academy, or Microsoft.

The Value of Curiosity-Driven Research

America is increasingly losing ground to other nations in research and development (R&D), particularly in the basic research that plays such a central role in American innovation. Basic research refers to scientific studies that aim to contribute to the larger body of knowledge and advance our understanding on the fundamental aspects of natural phenomena without the goal of a specific application or product. During and after World War II, the U.S. made a new national commitment towards sustaining curiosity-driven research at universities across the country. This basic research has led to many notable breakthroughs over the past sixty years, and these investments continue to drive the innovation of new products today. One of my colleagues on the Restoring the Foundation committee, Mark Fishman, the former President of Novartis Institutes for BioMedical Research, often observes that, on average, it takes forty years for a discovery in biology to lead to a new drug or product. For example, the development of recombinant DNA techniques in the 1970s spurred the biotechnology revolution, creating advancements in numerous industries including medicine, agriculture, and manufacturing. Recombinant DNA made possible the development of synthetic human insulin to treat diabetes, the hepatitis B vaccine, and crops engineered to be resistant to pests and chemicals. In short, it led to many billion-dollar industries and opened up new research frontiers.

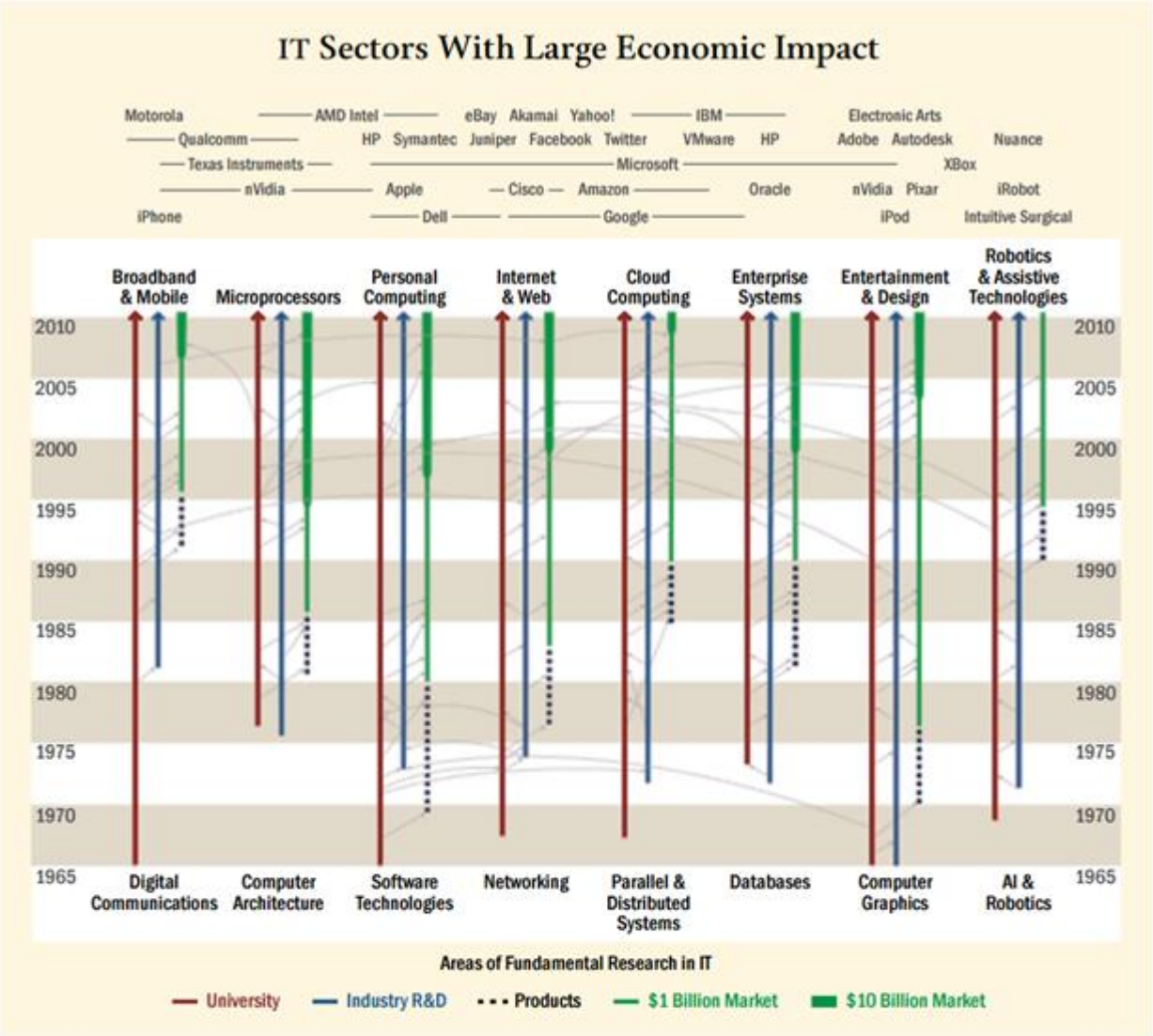
The far-reaching benefits of federally-supported research are not limited to the biomedical sciences. Last week, the Breakthrough Prize in Physics was awarded to the three founders of the Laser Interferometer Gravitational-Wave Observatory (LIGO) and the hundreds of other contributors to the project who, after many years of hard work, made the first direct detection of

gravitational waves predicted by Einstein a century ago. The National Science Foundation has been funding work that led to this discovery since the 1970s. Forty years later, the development of a tool to detect gravitational waves makes it possible to learn more about our universe and ask deeper questions about its origins. The technologies that made LIGO possible also have many additional uses and have facilitated the development and commercialization of new technologies such as creating more uniform optical coatings and improving materials used to build the structural components of aircraft.[1] In fact, most new technologies are traceable to research projects where the scientists could not foresee the future applications and impact of their work.

Curiosity-driven research not only leads to advances in medicine and technology, but is also responsible for fueling economic growth. Multiple economic analyses – including Nobel Prize winning research – support that over half of all sustained economic growth since World War II results directly from scientific and technological advances. Hundreds of companies have their origins in federally-funded research conducted in a university. In my field of Information Technology, basic research on parallel and distributed systems starting in the 1970s ultimately led to Cloud Computing, which has completely transformed how businesses in all sectors operate by facilitating the storage and on-demand retrieval and analysis of massive amounts of data.

Also in the 1970s, basic research in information retrieval and networking led to the internet search engines we take for granted today, completely transforming how people find information on the web and interact with each other professionally and socially. This pattern has been broadly true in Information Technology, as you can see in the graph below, which is often described as the "tire tracks" diagram. This graph, which is reproduced from the 2012 National Academies report *Continuing Innovation in Information Technology*, depicts the network of university and industry contributions that over the years has led to the creation of information technology firms and products with $1 billion and even $10 billion markets.[2] These innovations not only led to new industries, but also profoundly changed society in ways that we never could have predicted.

[1] Advanced LIGO: Extending the Physics Reach of LIGO. https://www.advancedligo.mit.edu/tech_overview.html
[2] Source: National Research Council, *Continuing Innovation in Information Technology* (Washington, D.C: The National Academies Press, 2012), 3.



Innovation is Not Linear, but a Highly Interconnected Web

Examples of the contributions of federally supported fundamental research to the creation of information technology (IT) firms and products with large economic impact. Red tracks: university-based research. Blue tracks: industry R&D. Dashed black lines: periods following the introduction of significant commercial products resulting from fundamental research. Green lines: billion-dollar-plus industries (by annual revenue) stemming from fundamental research. Thick green lines: achievement of multibillion-dollar markets by some industries. Arrows between tracks: multidirectional flows of ideas, technologies, and people. Top rows: present-day it market segments and representative U.S. firms and products whose creation was stimulated by the research represented by the red and blue vertical tracks. Bottom row: areas of fundamental research in it.

Source: National Research Council, *Continuing Innovation in Information Technology* (Washington, D.C.: The National Academies Press, 2012), 3.

From *Restoring the Foundation: The Vital Role of Research in Preserving the American Dream* (American Academy of Arts & Sciences, 2014)

I hope it is evident that while basic research may have no *intended* end goal, it is in fact the foundation of American prosperity and progress.

Improving U.S. Innovation Competitiveness

While most of America's innovations, as well as its quality jobs, are created in private industry, companies depend on a continuous stream of new scientific discoveries and early-stage technologies that flow from the federal government's investments in research, particularly basic research, carried out at research universities and national laboratories. So it is alarming that the federal government's investment in basic research has been slowly eroding over the past two decades – and it should be alarming not just for the scientific community, but for the entire American people. This concern motivated the American Academy to assemble a committee of 25 leaders spanning the research enterprise – including from government, universities, businesses and industry – to consider how to address this issue. The committee published *Restoring the Foundation* in September 2014. The report summarizes the committee's recommendations for policy changes in academia, industry, and government. *Restoring the Foundatio*n was immediately endorsed by leaders throughout the private and public sectors, including the Presidents of Merck, the Business Roundtable, the Association of American Universities, and the Association of Land-grant and Public Universities, among many others.

Nearly two years ago, report co-chair Neal Lane had the chance to testify before this committee in advance of the report's publication. I am pleased to be here today to discuss the committee's published recommendations and the impressive amount of backing that the work has received across all sectors of the economy. We have had many opportunities to discuss the report with individual Members and have greatly appreciated the substantial interest and support our recommendations have received from both sides of the aisle.

Restoring the Foundation focuses particularly on basic research, the imperiled foundation upon which the nation's leadership in innovation and prosperity rests. The report offers recommendations to meet three critical objectives:

- ***Ensure*** *that the American people receive the maximum benefit from federal investments in research;*

- ***Regain*** *America's standing as an innovation leader by establishing a more robust national government-university-industry research partnership; and*

- ***Secure*** *America's leadership in science and engineering research – especially basic research – by providing sustainable federal investments.*

I will use the rest of my testimony to describe in detail a few specific recommendations that may be especially helpful for this Senate committee to consider as it explores ways to promote the health and productivity of American research. There are several recommendations from *Restoring the Foundation* that I will not cover here, such as on capital budgeting for research instrumentation; university cost-containment efforts and resource sharing with outside parties; and expanding the science, engineering and technology assessment capabilities of the Government Accountability Office. More information on these recommendations can be found in our report, and I would also be happy to discuss any questions you may have at a later date.

Ensuring that the American People Receive the Maximum Benefit from Federal Investments in Research

A skilled workforce provides a tremendous return on federal investment; therefore, it is imperative that scientists and engineers dedicate the majority of their time to the research activity that drives the U.S. innovation ecosystem. However, added rules and regulations have diverted researchers' time and focus from their intended jobs and created unnecessary administrative overhead. The National Science Board's 2014 report, *Reducing Investigators' Administrative Workload for Federally Funded Research*, cited a 2005 finding from the Federal Demonstration Partnership that federally-supported researchers spend, on average, 42 percent of their time on administrative tasks. Seven years later, that average remained at 42 percent despite collective efforts to alleviate regulatory burdens on researchers.

In light of recent recommendations issued by the National Academies of Sciences, Engineering, and Medicine in their 2015 report *Optimizing the Nation's Investment in Academic Research: A New Regulatory Framework for the 21st Century*, the time is right for Congress to consider implementing specific changes to reduce the amount of paperwork that is required of researchers. Here I would like to acknowledge the leadership that Senators Lamar Alexander and Patty Murray have shown in encouraging the Senate Committee on Health, Education, Labor, and Pensions to advance a number of the recommendations contained in the National Academies report. I urge this committee to do the same for the agencies under your jurisdiction.

Merit-based peer review has long been upheld by researchers as the gold standard for ensuring scientific excellence, integrity, competitiveness as well as the most effective use of taxpayer dollars. *Restoring the Foundation* asks Congress to reaffirm that this gold standard should remain the practice for awarding research grants in America, leaving primary responsibility for evaluating the scientific merit of the research proposals in the hands of the relevant agencies and scientific experts. I should note that the American Academy committee has been gratified that so many in Congress on both sides of the aisle agree with this principle, and that this Senate committee has upheld it for the agencies under its jurisdiction – including in the case of the social and behavioral sciences and the research in these fields that is so important for understanding the challenges we face as a country. For example, in my field of Information Technology, social science research continues to suggest new approaches for thwarting cybercrime and protecting American's privacy and security in an increasingly connected world.

Regain America's Standing as an Innovation Leader by Establishing a More Robust National Government-University-Industry Research Partnership

The report committee makes several recommendations to strengthen ties between government, universities, and industry. American companies today–most of them lacking large central research operations and some of them, including those in the pharmaceutical sector, having considerably reduced their R&D activity–have formed collaborations with universities and national laboratories that over time could develop as a national partnership. But there are still barriers that require our attention, including policies on intellectual property, management of potential conflicts of interest, and publication restrictions.

I would like to focus on one of the report committee's suggestions regarding technology transfer. Specifically, the committee suggests that Congress assist academic institutions in adopting new technology transfer policies that would promote innovation and job creation while reducing the time and cost of licensing. The Bayh-Dole Act, which allows universities, small businesses, and nonprofit organizations to pursue ownership of an invention arising from federally funded research, has been highly effective in advancing to market the intellectual property (IP) generated from federally funded research. Over several decades, however, it has become clear that modification of certain policies and regulations could further propel the flow of IP to market by promoting start-ups and government-university-industry partnerships. The majority of universities have found that the cost of maintaining a technology transfer office, filing for patents, and negotiating IP licensing exceeds the income generated from licensing. Licensing negotiations with companies can also pose a high barrier to collaboration, often delaying or preventing the transfer of technologies to a company and, potentially, to market.

More universities should experiment with new policies to enhance the transfer of IP to the market. My previous employer, Carnegie Mellon University (CMU) has fundamentally changed the way it approaches technology commercialization. The University deemphasized revenue generation and created a process dubbed by former CMU Provost Mark Kamlet as the "5 percent and go in peace" policy, which eliminated or greatly reduced the need for faculty to negotiate with the institution.[3] The outcomes of these policies should be evaluated to derive best practices, while staying mindful of potential conflicts of interest, restrictions on public access to research results, and the potential for resulting constraints on future research conducted in university and government laboratories.

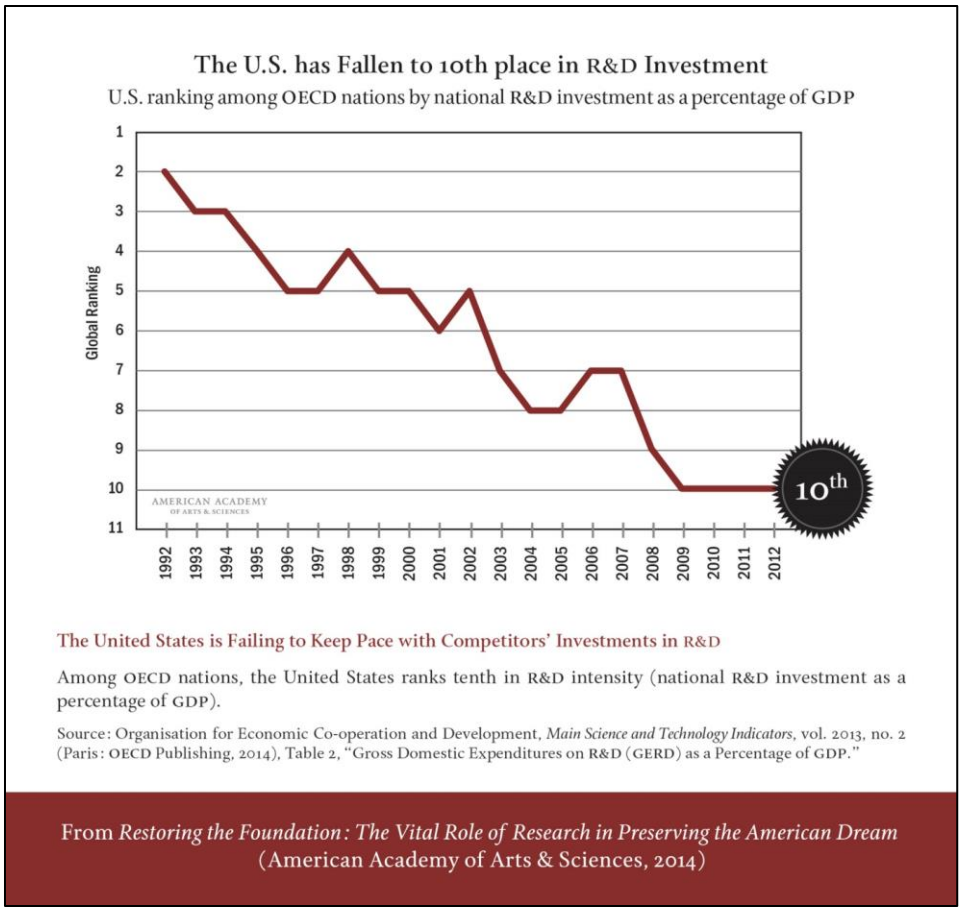
Secure America's Leadership in Science and Engineering Research – Especially Basic Research – by Providing Sustainable Federal Investments

I would be remiss if I did not mention our committee's recommendations pertaining to the federal investment in science. The committee recognizes that we are in a time of fiscal constraint

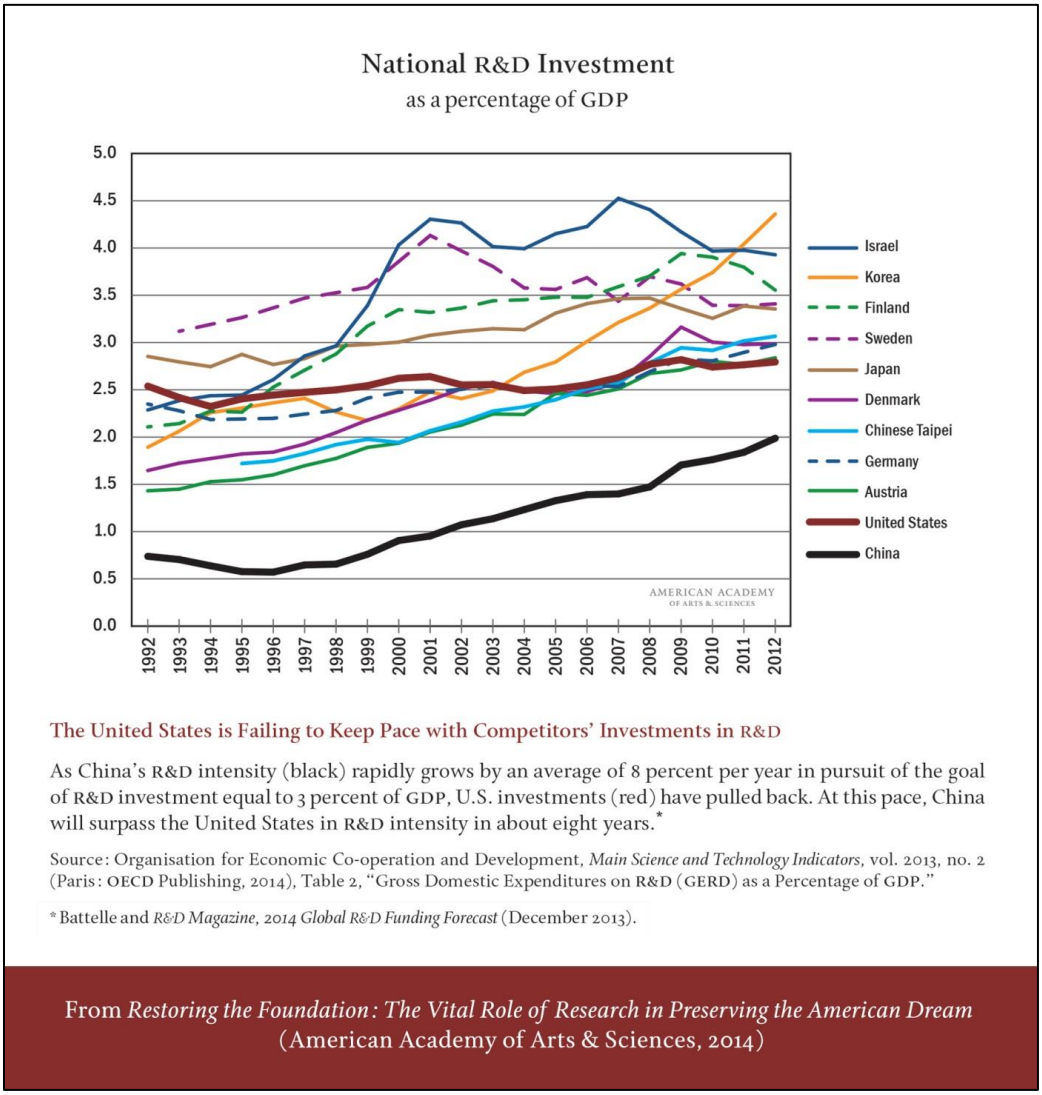
[3] See Focus Section C, pg. 71, from the 2014 American Academy of Arts and Sciences report *Restoring the Foundation: The Vital Role of Research in Preserving the American Dream.*

and that Congress has many priorities. Nevertheless, after much analysis and debate, we concluded that the U.S. will not remain competitive with other countries unless we find a way to increase funding in basic research.

While the U.S. was the global leader in science innovation for years, it has recently forfeited this position to other countries like Korea and Japan, as the U.S. investment in R&D continues to fall short of other nations. The total U.S. investment (public and private) in R&D measured as a percentage of GDP – an accepted metric for the country's commitment to the future of its citizens – continues to fall short of the national goal of at least 3% adopted by several U.S. presidents, even as America's economic competitors move aggressively to increase their own investments in innovation. As the following graph shows, the US has dropped to 10th place globally in investments in R&D when measured as a function of economic output. And even in basic research, long a particular area of strength for the United States, we are now in 7th place by this measure.



And as the next graph shows, other nations are well on their way to achieving the goal of investing at least 3% GDP in R&D, and many have surpassed it. China will pass us in absolute R&D spending within eight years.



The United States is Failing to Keep Pace with Competitors' Investments in R&D

As China's R&D intensity (black) rapidly grows by an average of 8 percent per year in pursuit of the goal of R&D investment equal to 3 percent of GDP, U.S. investments (red) have pulled back. At this pace, China will surpass the United States in R&D intensity in about eight years.*

Source: Organisation for Economic Co-operation and Development, *Main Science and Technology Indicators*, vol. 2013, no. 2 (Paris: OECD Publishing, 2014), Table 2, "Gross Domestic Expenditures on R&D (GERD) as a Percentage of GDP."

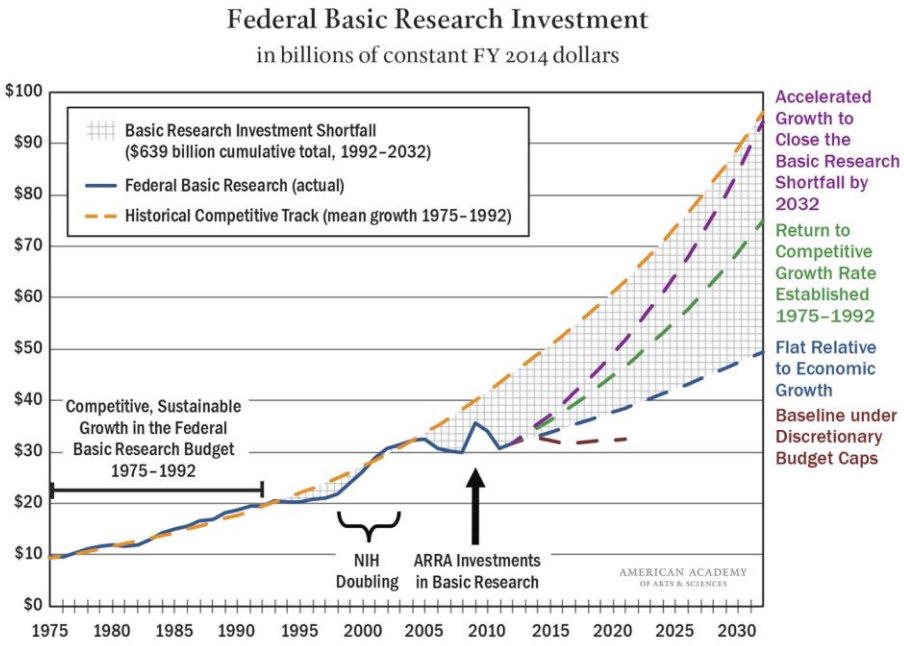
* Battelle and *R&D Magazine*, *2014 Global R&D Funding Forecast* (December 2013).

From *Restoring the Foundation: The Vital Role of Research in Preserving the American Dream* (American Academy of Arts & Sciences, 2014)

With these concerns in mind, the committee recommends that the country commit to an annual real growth rate of at least 4% for basic research. We recognize that the country is still recovering from the recent recession, yet as *Restoring the Foundation* notes, from 1975 to 1992 the federal investment in basic research grew at an average annual inflation-adjusted rate of 4.4% despite serious political and economic challenges, including the 1973 oil embargo, the Great

Inflation of 1979-1982, and the final tumultuous years of the Cold War. During this period, Republicans and Democrats, in spite of a number of policy differences, were in agreement that federal funding of basic research was a national priority. However, in the subsequent two decades, from 1992-2012, even taking into account the doubling of the NIH budget, the average growth rate was roughly 0%. It is notable that 1992, the last year the U.S. had a 4% growth rate in basic research, is also the year that the U.S. began falling behind other nations in our R&D investment. The following graph illustrates these data:

A 4%



Getting U.S. Basic Research Back on Track

Should federal obligations for basic research (blue) flatline relative to economic growth, the United States will by 2032 have accumulated a $639 billion shortfall (cross-hatch) in federal support of basic research relative to the 4.4 percent average annual real growth trend (orange) established during the period of 1975 to 1992. This committee recommends that the nation return to this historical competitive growth rate (green), with the ultimate goal of fully closing the basic research shortfall (purple) as the economy improves.

Note: Orange trend line is a best fit (least squares regression) of federal obligations for basic research (constant 2014 dollars) between 1975 and 1992.

Source: Federal obligations for basic research from 1975 to 2012 are from National Science Board, *Science and Engineering Indicators 2014* (Arlington, Va.: National Science Foundation, 2014), Appendix Table 4-34, "Federal Obligations for R&D and R&D Plant, by Character of Work: FYs 1953–2012." Basic research funding baseline projections are based on the nondefense discretionary funding levels from the Office of Management and Budget, *Fiscal Year 2015 Budget of the U.S. Government* (Washington, D.C.: Office of Management and Budget, 2014), Table S-10, "Funding Levels for Appropriated ('Discretionary') Programs by Category," whose baseline levels assume Joint Committee enforcement cap reductions are in effect through 2021. GDP projections assume an average real annual growth rate of 2.2 percent until 2020 and 2.3 percent from 2020 to 2030, according to Jean Chateau, Cuauhtemoc Rebolledo, and Rob Dellink, "An Economic Projection to 2050: The OECD 'ENV-Linkages' Model Baseline," *OECD Environment Working Papers*, No. 41 (Paris: OECD Publishing, 2011), Table 4, doi:10.1787/5kgondkjvfhf-en.

From *Restoring the Foundation: The Vital Role of Research in Preserving the American Dream*
(American Academy of Arts & Sciences, 2014)

growth rate is a modest number when applied to basic research. Since the federal investment in such research is roughly $30 billion per year, 4% growth corresponds to a long-range target of increasing the federal basic research investment from 0.2% to 0.3% of GDP over a period of 10 to 15 years. We have been very encouraged by the bipartisan interest in supporting science and engineering and the general agreement with the imperative of establishing a sustainable growth trajectory for basic research. Importantly, our committee recommended that any additional investment in basic research should not come at the expense of federal support for applied research and development or funding for specific scientific fields. These investments are also critical for America's global competitiveness and such a trade-off would thus be counter-productive.

Both the federal government and industry contribute to R&D. But although U.S. industry funds and performs roughly 2/3 of the nation's R&D, these activities focus primarily on development rather than basic research. While my company continues to benefit from a robust research program, most companies lack large central research operations and cannot afford to fund basic research due to the risk of being penalized by corporate shareholders who do not prioritize such long-term investments. Additionally, while most of America's innovations, as well as its quality jobs, are created in private industry, companies depend on a continuous stream of new scientific discoveries and early-stage technologies that flow from the federal government's investments in research, particularly basic research, carried out at research universities and national laboratories. This is clearly depicted in the tire tracks diagram discussed earlier. Federal investments in research also support the training of future scientists and engineers through graduate programs and postdoctoral fellowships, functioning to replenish the scientific workforce and fuel the talent pipeline.

For these reasons the federal government will remain the primary funder of the fundamental, curiosity-driven research on which all innovation depends. While the scientific community recognizes that this is a period of financial constraint for the federal government, it is imperative that the government recognizes that investments in basic science research are just that – investments. To address U.S. global innovation competitiveness, we must reexamine our basic

science research enterprise and determine how to ensure that the American people receive the maximum benefit from federal investments in research and identify how the federal government can support a sustainable trajectory for future research.

Steady, sustainable increases in federal investment would go a long way to restoring American leadership. The current strategy for federal research funding relies on annual budget cycles, hindering the long-term planning required to give researchers predictability for successfully executing groundbreaking research, and resulting in costly inefficiencies in grant programs. The committee recommends that the President and Congress adopt a more strategic, multiyear approach to funding that better reflects the long-term nature of basic research, possibly through a rolling 5-10 year plan. Multiyear appropriations should be prioritized for agencies that primarily support research and graduate STEM education to strengthen the future research workforce. We also recommend that the White House Office of Management and Budget establish a strategic capital budget process for federal R&D, particularly the construction of research instrumentation and facilities that take many years to plan and build.

Overwhelming Support

Since the release of *Restoring the Foundation*, members of the report committee and American Academy staff have met with many Members of Congress and their staff from both sides of the aisle, including meetings with Senators from this committee, to discuss the report recommendations. The overwhelmingly supportive response is a true testimony to the bipartisan spirit of these recommendations. We are grateful for the thoughtful discussions with you and your staff about how to turn them into policy.

These recommendations have also found strong support in the business community. Last summer, ten CEOs and corporate chairmen – including the CEOs of Lockheed Martin, Northrop Grumman, Boeing, John Deere, Merck, Novartis, the National Association of Manufacturers, and my company, Microsoft – issued a call to action entitled "Innovation: An American Imperative." The statement, which is attached to this testimony, urges Congress to take decisive action to ensure the U.S. remains the leader in global innovation. The Innovation Imperative

identifies seven specific policy recommendations, many of which echo those in the *Restoring the Foundation* report, for how to achieve this goal:

1. Renew the federal commitment to scientific discovery
2. Make permanent a strengthened federal R&D tax credit
3. Improve student achievement in science, technology, engineering, mathematics (STEM)
4. Reform U.S. visa policy
5. Take steps to streamline or eliminate costly and inefficient regulations
6. Reaffirm merit-based peer review
7. Stimulate further improvements in advanced manufacturing

One of the proposed action items, making permanent the R&D tax credit for businesses, has already been implemented by Congress, which will encourage American corporations to strengthen their investments in long-range research.

I would like to draw attention to the Innovation Imperative recommendation on STEM education, since computer science education, namely computational thinking, has long been an interest of mine. Today computing touches every sector, every discipline, and every profession. Industry in all sectors recognizes the importance of computer science for their future and the demand for a workforce skilled in computing is increasing, far outweighing the supply.

The Innovation Imperative has now been endorsed by more than 325 leading companies and organizations representing science and engineering research, American industry, and higher education, including at least one from each of the 50 states. All have come together to say that a sustained commitment to basic research should be a high priority for Congress. I am extremely proud that my CEO, Satya Nadella, was among the corporate leaders who signed the Innovation Imperative. To me, it means Microsoft understands and believes in the value of basic research—for the company and for the country.

I am also enormously appreciative that Senators Lamar Alexander and Chris Coons, in addition to Representatives Derek Kilmer and Randy Hultgren, recently issued a Dear Colleague Letter in

support of the Innovation Imperative statement. This hearing provides another opportunity for Members of Congress to come together to find practical solutions to restoring research to its rightful place as a national priority and structuring the U.S. research enterprise to efficiently carry out that mission. I look forward to working with members of the Senate Committee on Commerce, Science and Transportation to explore how all stakeholders in the research system can get together to advance these goals.

Conclusion

Congress is poised to get the U.S research enterprise back on track, and your interest and hard work is greatly appreciated by the scientific community. I would like to close by emphasizing three policy recommendations that the American Academy committee that produced the *Restoring the Foundation* report believes are particularly crucial for the long-term prosperity of this nation, and have strong backing among businesses and universities alike: 1) relieving regulatory burdens that limit the productivity of America's researchers; 2) encouraging more robust research partnerships among federal and state governments, public and private universities, and industry; and 3) establishing sustainable annual real growth of at least 4% in the federal investment in basic research and a long-term investment goal of 0.3% of GDP. Failing to put these recommendations into action would put the U.S. at risk of conceding our leadership in basic research to our economic competitors around the world. Doing so would forfeit our leadership in the technologies and markets of tomorrow and the opportunity to create jobs at all stages of the innovation pipeline.

Thank you again for the invitation to speak before this committee today. Please do not hesitate to reach out to me, the American Academy staff, and our report committee if you would like to discuss our recommendations in more detail. I look forward to taking your questions.

INNOVATION: AN AMERICAN IMPERATIVE

A call to action by American industry, higher education, science, and engineering leaders urging Congress to enact policies and make investments that ensure the United States remains the global innovation leader.

Our nation knows what it takes to innovate: a sustained commitment to scientific research, a world-class workforce, and an economic climate that rewards entrepreneurship and innovation. As the most dynamic and prosperous nation in the world, the United States has long benefitted from policies and investments that have promoted innovation and in turn driven productivity and economic growth, bolstered American trade, ensured our health and national security, and safeguarded the American dream. Our leadership is now at risk because of years of under-prioritizing federal scientific research investments and policies that promote innovation.

Now is not the time to rest on past success. As noted by the American Academy of Arts and Sciences in its 2014 Report *Restoring the Foundation: The Vital Role of Research in Preserving the American Dream*, "There is a deficit between what America is investing and what it should be investing to remain competitive, not only in research but in innovation and job creation." Competitor nations are challenging our leadership by copying our playbook for success. At the same time our nation's support for scientific research and innovation is stagnating. If these trends continue, other countries will soon surpass the United States as the global innovation leader.

We must heed the warnings in the *Restoring the Foundation* report and other salient reports of the past decade and act decisively. In particular, Congress must:

Renew the federal commitment to scientific discovery

by ending sequestration's deep cuts to discretionary spending caps and providing steady and sustained real growth in funding of at least four percent for basic scientific research at: the National Science Foundation, the National Institutes of Health, the Department of Energy's Office of Science, the Department of Defense, NASA, the National Institute of Standards and Technology, USDA, and NOAA;

Make permanent a strengthened federal R&D tax credit

as a part of comprehensive tax reform to encourage more private-sector innovation investment here in America instead of in competitor countries;

Improve student achievement in science, technology, engineering, mathematics (STEM)

through increased funding of proven programs and incentives for science and math teacher recruitment and professional development;

Reform U.S. visa policy

to welcome and keep highly educated international professionals, particularly those holding STEM degrees from U.S. universities;

Take steps to streamline or eliminate costly and inefficient regulations

and practices governing federally funded research to help unburden researchers to focus more time on conducting research and training the next generation of scientists, engineers, health care professionals, and business leaders;

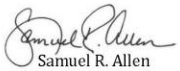
Reaffirm merit-based peer review

as the primary mechanism major federal agencies should employ in making competitive scientific research grants to ensure the most effective use of taxpayer dollars; and

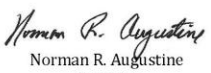
Stimulate further improvements in advanced manufacturing

through support for programs aimed at accelerating manufacturing innovation and new federal-industry-academic partnerships.

We, the signatories, urge support for these actions to keep the United States the global innovation leader. We stand ready to do our part.



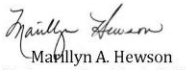
Samuel R. Allen
Chairman & CEO
John Deere



Norman R. Augustine
Co-Chair
Restoring the Foundation

Wes Bush
Chairman, President & CEO
Northrop Grumman

Kenneth C. Frazier
Chairman & CEO
Merck & Co., Inc



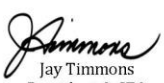
Marillyn A. Hewson
Chairman, President, & CEO
Lockheed Martin Corporation

Charles O. Holliday
Chairman
Royal Dutch Shell plc

Joseph Jimenez
CEO
Novartis

W. James McNerney, Jr.
Chairman of the Board & CEO
The Boeing Company

Satya Nadella
CEO
Microsoft



Jay Timmons
President & CEO
National Association of Manufacturers

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Academy of Radiology Research
Acoustical Society of America
Ad Hoc Group for Medical Research
Adv. Technical Intelligence Assn.
Aerospace Industries Association
Agricultural & Applied Economics Association
Aizoon Technology Consulting
AMD
American Academy of Arts & Sciences
American Anthropological Association
American Association for Dental Research
American Association for the Advancement of Science
American Association for the Study of Liver Diseases
American Association of Colleges of Pharmacy
American Association of Mycobacterial Diseases
American Association of Petroleum Geologists
American Association of Physical Anthropologists
American Association of Physicists in Medicine
American Association of Physics Teachers
American Association of State Colleges and Universities
American Astronomical Society
American Chemical Society
American Council on Education
American Dairy Science Association
American Dental Education Association
American Educational Research Association
American Geophysical Union
American Geosciences Institute
American Institute for Medical & Bio. Engineering
American Institute of Aeronautics and Astronautics
American Institute of Chemists
American Institute of Physics
American Mathematical Society
American Meteorological Society
American Physical Society
American Physiological Society
American Phytopathological Society
American Political Science Association
American Psychological Association
American Society for Biochemistry and Molecular Biology
American Society for Engineering Education
American Society for Microbiology
American Society for Nutrition
American Society of Agronomy
American Society of Animal Science
American Society of Plant Biologists
American Sociological Association
American Veterinary Medical Association
Anchorage Economic Development Corporation
Applied Materials, Inc
Archaeological Institute of America
Arizona Nevada Academy of Science (ANAS)
Arizona State University
Arkansas Research Alliance
Arkansas State University
ASME
Association for Information Science and Technology
Association for Psychological Science
Association for Women in Mathematics
Association for Women in Science
Association of American Geographers
Association of American Medical Colleges
Association of American Universities
Association of American Veterinary Medical Colleges
Association of Independent Research Institutes
Association of Public and Land-grant Universities
Association of Research Libraries
Association of University Technology Managers
ASTRA, Alliance for Science & Technology Research in America
Auburn University
Battelle
Bay Area Council
Biophysical Society
Biotechnology Industry Organization
Boise State University
Boston University
Botanical Society of America
Brandeis University
Brown University
Business-Higher Education Forum
California Institute of Technology
California Polytechnic State University
Carnegie Mellon University
Cary Institute of Ecosystem Studies
Case Western Reserve University
Center for Policy on Emerging Technologies
Clemson University
Coalition for Aerospace and Science
Coalition for National Science Funding
Coalition for National Security Research
Colorado School of Mines
Colorado State University
Columbia University
Computing Research Association
Consortium for Ocean Leadership
Consortium of Social Science Associations
Cornell University
Council of Graduate Schools
Council of Scientific Society Presidents
Council on Competitiveness
Council on Governmental Relations
Crop Science Society of America
Delaware State University
Duke University
Earthquake Engineering Research Institute
East Carolina University
Ecological Society of America
EDUCAUSE
Emory University
Energy Sciences Coalition
Entomological Society of America
EPICenter Memphis
FASS
Federation of American Societies for Experimental Biology
Federation of Associations in Behavioral and Brain Sciences
Florida State University
Foundation for Science and Disability
Genetics Society of America
Geological Society of America
George Mason University
Georgia Institute of Technology
Georgia Regents University
Georgia Research Alliance
Georgia State University
Google
Greater Boston Chamber of Commerce
Greater Madison Chamber of Commerce
Harvard University
Hawaii Academy of Science
Hepatitis B Foundation
Hewlett-Packard Company
Human Factors and Ergonomics Society
IBM
Idaho Academy of Science and Engineering
IEEE-USA
Indiana University
Infineon Technologies Americas Corp.
Information Technology Industry Council (ITI)
Innovation Associates
Institute of Food Technologists
Intel Corporation
International Economic Development Council
International Society for Educational Planning
International Society for the Systems Sciences
International Technology and Engineering Educators Assn.
Iowa State University
IPC - Association Connecting Electronics Industries
Jefferson Science Associates LLC
Kansas State University
Kent State University
Kentucky Academy of Science
Lehigh University
Linguistic Society of America
Louisiana Tech University
Louisiana State University
Lowell Observatory
Maine State Chamber of Commerce
Massachusetts Institute of Technology
Materials Research Society
Mathematical Association of America
Michigan State University
Michigan Technological University
Micron Technology Inc
MN-SBIR
Montana State University
National Alliance for Eye and Vision Research
National Association of Colleges and Employers
National Association of Geoscience Teachers
National Association of Graduate-Professional Students
National Association of Marine Laboratories
National Center for Science Education
National Center for Technological Literacy- Museum of Science
National Coalition for Food and Agricultural Research
National Council for Science and the Environment
National Defense Industrial Association
National Ground Water Association
National Science Education Leadership Association
National Science Teachers Association
New Mexico State University
New York University
North Carolina Academy of Science
North Carolina State University
North Dakota State University
Northeastern University
Northern Illinois University
Ohio University
Oklahoma Academy of Science
Oklahoma State University
ON Semiconductor
ONAMI
Oregon State University
Pace University
Parapsychological Association
Penn State University
Phiston Technologies, Inc.
Population Association of America
Portland State University
Poultry Science Association
Princeton University
Qualcomm
Rensselaer Polytechnic Institute
Research!America
Rice University
Rochester Institute of Technology
Rutgers, the State University of New Jersey
SAGE
Semiconductor Equipment & Materials International (SEMI)
Semiconductor Industry Association
Semiconductor Research Corporation
Sigma Xi
Silicon Valley Leadership Group
Small Business Technology Council
Society for In Vitro Biology
Society for Industrial and Applied Mathematics
Society for Industrial and Organizational Psychology
Society for Neuroscience
Society of the Study of Evolution
Society of Toxicology
Soil Science Society of America
South Dakota School of Mines & Technology
South Dakota State University
Southeastern Universities Research Association
Southern Illinois University System
SPIE, the international society for optics and photonics
SRI International
SSTI
Stanford University
State University of New York
Stillwater Chamber of Commerce
Stony Brook University
Supporters of Agricultural Research Foundation
Syracuse University
Task Force on American Innovation
Technology Association of Georgia
TechVision21
Texas A&M University
Texas Instruments Incorporated
Texas Tech University
The Coalition for the Life Sciences
The College of William and Mary
The Electrochemical Society
The Industrial Research Institute
The Johns Hopkins University
The New England Council
The Ohio State University
The Optical Society
The Procter & Gamble Company
The Science Coalition
The University of Alabama at Birmingham
TIES - Teaching Institute for Excellence in STEM
Tri-City Development Council – Tri-Cities, WA
Tufts University
University Economic Development Association
UNAVCO
United for Medical Research
Universities Research Association
University at Buffalo, State University of New York
University City Science Center
University Corporation for Atmospheric Research
University of Alaska
University of Alaska Fairbanks
University of Arizona
University of Arkansas
University of Arkansas at Little Rock
University of California System
University of California, Berkeley
University of California, Davis
University of California, Irvine
University of California, Los Angeles
University of California, Merced
University of California, Riverside
University of California, San Diego
University of California, San Francisco
University of California, Santa Barbara
University of California, Santa Cruz
University of Central Florida
University of Cincinnati
University of Colorado at Colorado Springs
University of Colorado Boulder
University of Colorado Denver
University of Colorado, Anschutz Medical Campus
University of Connecticut
University of Delaware
University of Florida
University of Georgia
University of Hawaii
University of Illinois
University of Illinois at Chicago
University of Illinois at Urbana-Champaign
University of Iowa
University of Kansas
University of Louisville
University of Massachusetts Amherst
University of Maryland
University of Michigan
University of Minnesota
University of Mississippi
University of Missouri System
University of Nebraska
University of Nevada, Reno
University of New Hampshire
University of New Mexico
University of North Carolina at Chapel Hill
University of North Carolina System
University of North Carolina Wilmington (UNCW)
University of North Dakota
University of Notre Dame
University of Oklahoma
University of Oregon
University of Pennsylvania
University of Pittsburgh
University of Rochester
University of South Dakota
University of South Florida
University of Southern California
University of Tennessee
University of Toledo
University of Vermont
University of Virginia
University of Washington
University of Wisconsin System
University of Wisconsin-Madison
University of Wisconsin-Milwaukee
University of Wyoming
Utah State University
Van Fleet & Associates
Vanderbilt University
Vermeer Corporation
Washington State University
Washington State University, Tri Cities
Washington University in St. Louis
Wayne State University
West Virginia University
Western Massachusetts Economic Development Council
Western Michigan University
Wichita State University
Woods Hole Oceanographic Institution
Yale University