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Government Assistance to and Policy toward Innovation

Kelly H. Carnes

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dozen good entrepreneurs and put them in front of one piece of intellectual property, they will find at least a half dozen market opportunities for innovations coming out of that. So, nonexclusive licenses, exclusive in a domain, not exclusive for all domains might be what is needed.

That concludes my overview. Thank you.

PROFESSOR KING: Thank you very much.

UNITED STATES SPEAKER

The Honorable Kelly H. Carnes[‡]

MR. SISTO: Thank you, Tom. I think it was a very thorough presentation, and I like the road map, and we can all now understand the commercialization of university based IP, so when we get that question in the future, we can refer to it. I tried to follow with numbers on the diagram but gave up after about ten.

Our next speaker will be Kelly Carnes, and she will be speaking on U.S. innovation policy: Past, present, and future. She brings a distinguished background with her to this presentation. Currently, she is president of Tech Vision 21, a D.C. based technology-based strategy firm; seems to be well known by many members of the audience, who referred to her upcoming presentation and looking forward to hearing it. She previously served in the White House as a technology policy advisor as well as for four different Secretaries of Commerce, two of whom she served as Assistant Secretary of Commerce. Tech Vision 21 includes global companies, U.S. research universities, foreign governments, science, technology, and nonprofit organizations among their impressive client list. Her presentation, which I had an opportunity to preview, is going to give us a good historical basis for understanding

[‡] Kelly Carnes is President and CEO of TechVision21, a Washington, D.C.-based technology strategy firm. TechVision21 clients include global companies, prestigious U.S. research universities, foreign governments and science and technology nonprofit organizations. Previously, Ms. Carnes served in the White House and, later, as a trusted technology policy advisor to four Secretaries of Commerce. As a presidential appointee, Ms. Carnes frequently testified before Congress, represented the United States in negotiations with foreign governments, and served as a liaison to, and advocate for, the technology business community. As Assistant Secretary of Commerce for Technology Policy, Ms. Carnes was as a key point person on numerous high profile issues affecting technology businesses. Ms. Carnes has also served on a National Governors' Association Commission on Technology and Adult Education, the Steering Committee for the Commission on the Advancement of Women and Minorities in Science, Engineering and Technology (the "Morella Commission") and review panels for the National Science Foundation's Small Business Innovation Research program.

hopefully the current state and future of technology innovation policy in the United States government. Kelly?

HON. KELLY CARNES: Thank you. Everybody needs to bear with me for a second while I get the computer set up. Good, it worked; alright. Thank you so much, Henry, for creating the opportunity for us all to be here today, and congratulations on what has already been a very enlightening event, and I am sure will be throughout the two days.

I want to breeze through as quickly as possible about 100 years of U.S. innovation policy and spend most of my time talking about the present and future state. But, I thought I would give everybody the historical context because it is kind of interesting. U.S. innovation policy goes all the way back to the United States Constitution, where we created a federal responsibility for promoting science and the useful arts.

We put a process for patent and copyright directly into the constitution;²⁰ these things were clearly on the minds of the Founders of the United States. In 1862, we had a Land Grant Act, establishing land grant universities and agricultural, scientific and industrial studies.²¹ Those have played a tremendous role in United States economic development and in the agriculture extension program, which comes up, I think, on the next slide. It has been a tremendous success at bringing the latest in knowledge and techniques out to farmers and/or other agricultural producers all over the country. The National Bureau of Standards came about in 1901²², and was the precursor of today's National Institute of Standards and Technology.²³ That agency was created as a result of the recognition of the need for common standards, common measurements in industry.²⁴ Then we have a precursor to NASA as early as 1915²⁵, and then everybody is familiar with the Manhattan Project²⁶ and the creation of the first national labs in the '40s.²⁷

Tom mentioned Vannevar Bush and the important role he played right after World War II in really shaping what the United States has done in technology and innovation policy. I actually like to say that the 2006 U.S. innovation policy was created by Mr. Bush, not today's president, not his father,

²⁰ U.S. CONST. art. 1, § 8, cl. 8.

²¹ Morrill Land Act, ch. 130, 12 Stat. 503 (1862), amended by 7 U.S.C. §§301-308.

²² Linda A. Mabry, *Multinational Corporations and U.S. Technology Policy: Rethinking the Policy of Corporate Nationality*, 87 GEO. L.J. 563, n.358 (1999).

²³ *Id.*

²⁴ *Id.*

²⁵ EDMUND PRESTON, U.S. CENTENNIAL OF FLIGHT COMMISSION, THE GOVERNMENT ROLE IN CIVIL AVIATION – AN OVERVIEW, U.S. CENTENNIAL OF FLIGHT COMMISSION, http://www.centennialofflight.gov/essay/Government_Role/POL-OV.htm (last visited Oct. 4, 2006).

²⁶ Rory Richards, 'Father' of America's National Labs Subject of New Exhibit, INSIDE SCIENCE NEWS SERVICE, <http://www.aip.org/isns/reports/2002/042.html> (last visited Oct. 4, 2006).

²⁷ *Id.*

George H. W. Bush, but by Vannevar Bush. But for the most part, the policy regime and the philosophical underpinnings Bush created for Truman in the 1940s still guide what we do in the United States today. As Tom said, that's been a tremendous blessing to the United States. Bush's foresight and vision have created tremendous intellect in the investments that we have made in basic research through the National Science Foundation. The whole notion of the federal government investing in research to support its own mission needs, and different missions, has been added to the federal portfolio over the years. We started with the Cold War, the space race, and defense kinds of portfolios; we added health, energy, and environment. Our most recent new federal mission showed up just a few years ago in Homeland Security, and we now have a major investment portfolio that is focused around that. There have been tremendous benefits from all of that.

In 1964, the federal R & D investment exceeded the combined public and private investments of the rest of the world²⁸, and one thing that is important, when you start thinking about the future of the United States and North America, is how different a posture we have now sitting here in the 21st century than we had at the time when we really dominated the world's R & D investment. I think now the United States public and private investments combined are responsible for still about a third of the world's R & D.²⁹ It is still significant and very important, but dramatically reduced from what it was in the '60s that Kent alluded to. For example, the competitive challenges during the 1980s, and the rise of concern with competitiveness, the formation of the organization that Kent headed - the Council on Competitiveness - where we had United States CEOs and university presidents coming together for the first time talking to federal policy makers and others about the importance of thinking about competitiveness, about trying some new models, and moving toward some policy initiatives that would mean more close collaboration among some of the actors and the United States innovation system.

And some of the important legislation and policy initiatives that occurred during the 1980s includes the Stevenson-Wydler Act,³⁰ which for the first time called for a formal technology policy and linked technological innovation to the economy,³¹ The Bayh-Dole Act, as Tom well pointed out, had a significant impact in the United States because instead of vesting ownership

²⁸ See generally Gregory Tassej, *Policy Issues for R&D Investment in a Knowledge-Based Economy*, 29 J. TECH. TRANSFER 153, 172 (2004), available at <http://www.nist.gov/director/planning/investment-JTT-2004.pdf>.

²⁹ KEI KOIZUMI, AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (AAAS), FEDERAL R&D IN THE FY 2007 BUDGET: AN INTRODUCTION, AAAS REPORT XXXI: RESEARCH AND DEVELOPMENT FY 2007, <http://www.aaas.org/spp/rd/07pch1.htm> (last visited Oct. 4, 2006).

³⁰ Stevenson-Wydler Technology Innovation Act, 15 U.S.C. § 3701 (1980).

³¹ *Id.*

in the federal government for intellectual property created as a result of federal R & D investments, it changed the framework to vest that ownership in universities and in small business.³² The rationale behind that was this ownership structure gave the universities and small business a powerful incentive to actually commercialize the technology rather than letting it sit on the shelf. It might be interesting to discuss how successful that has been. I would personally say that Bayh-Dole was extremely successful for a number of years because it did create incentives. However, I think that it is probably time to revisit the Bayh-Dole framework as we go forward; so don't adopt it anywhere else.

We will work on it here, and the reason I say that is because so many universities in the United States follow Tom's model of trying to look at their portfolio of intellectual property as a profit center for the university - as opposed to thinking about what the university's role is in actually seeing that that technology gets commercialized - and how that actually benefits the national economy. And I think it creates some perverse incentives in the university infrastructure, and hopefully, no one will throw tomatoes when I say that. Also, in the '80s, we had the National Cooperative Research Act that reduced antitrust barriers for pre-competitive collaborative R & D,³³ Kent mentioned there were a whole lot of people thinking about that as an important element of what public and private sector entities should be doing in R & D.

The Federal Technology Transfer Act gave the federal laboratories the authority and responsibility to work on collaborative projects with United States industry,³⁴ and there has been a lot of growth in those kinds of relationships over the years. Not on this slide, but also important, was Sematech, which was really, I would say, a United States example of actual industrial policy, where we looked at the semiconductor industry.³⁵ We thought it was so critically important to maintaining capability in semiconductors as part of the United States industrial base that we actually had an affirmative program for a number of years to make significant investments with the private sector. The federal investments in semiconductors resulted in everything from computers to the internet, to jet aircraft, to biotechnology, to some other things. My favorite on this list is the high speed dental drill because I am not sure that that's really an advance in technology, but we take credit for it anyway.

During all this time, somewhat of a consensus developed on the overall policy framework and the critical elements performing an innovation or

³² Bayh-Dole Act, *supra* note 19.

³³ National Cooperative Research Act, Pub. L. No. 98-462, § 1841, 98 Stat. 1815 (1984).

³⁴ Federal Technology Transfer Act, 15 U.S.C. § 3710a (2000).

³⁵ See Brown & Linden, *General Discussion*, http://www.brookings.edu/es/commentary/journals/tradeforum/2005btf_brown_gd.pdf (last visited Oct. 5, 2006).

technology policy, and Kent and I like to refer to this in the Government as the four pillars, which were the critical elements of United States policy, I would say, throughout the late '80s and through most of the '90s, creating an innovation friendly business climate. The notion here is that it is not the role of the Government to commercialize technology or to compete, but it is the role of the Government to create an atmosphere in which competition can flourish, and there are so many laws and regulations that impact on that, everything from trade to environmental regulations, to product liability, to tort issues, all make a difference.

Just to give one small example, one of the things we did study in the late '90s and one of the things we noticed about environmental regulations in the United States was that the rise of the environmental regulatory regime from the '70s to '80s actually drove innovation for about 15 to 20 years because companies were scrambling to develop technologies that could meet these new environmental protection requirements. But once everybody had reached the level of compliance required by the statute, that kind of became a floor, and there was no incentive built into the system for anybody to do anything that was better than the regulations required. Companies who were capable of doing zero emission factories got no benefit, no economic incentive, out of it. So then toward the end of the '90s you started to see a whole lot of other countries that were then putting their environmental regimes in place, to start attracting a lot of R & D in the environmental technology area and to be developing innovative technologies, more innovative than what a lot of United States companies were doing. So that illustrates the impact of those kinds of regulatory issues; the other components here I think are obvious, investing in infrastructure, not just the physical plant and equipment, in roads and bridges and air traffic controller systems, which remain important, but over the years investing in the IT, in telecommunications infrastructure, in broadband capacity, all the things that make innovation possible as well as the work force.

Now I am going to turn to some of the issues that are being debated or have been debated in the past few years. For about fifteen years now, we have had a debate between Democrats and Republicans on some of these fundamentals. Most everyone agrees that key elements of a policy continue to include funding for basic research, funding to support the training of scientists and engineers, to the extent possible, working through Bayh-Dole and other kinds of tech transfer programs so that federal investments actually are commercialized or university investments are commercialized. The innovation friendly business climate and open markets policy is all relatively well agreed upon within the United States. However, Republicans look on all these issues from a totally free market *laissez faire* perspective. They have a very, very strong I would say, almost a religious fervor against things that would be defined as corporate welfare or industrial policy. They do not like to see government investments supporting anything where you have a private

sector role of any kind and really very much that goes beyond basic research. We went through a number of years where any kind of investment, even for Government mission purposes in applied research or development outside of the DOD portfolio, was somewhat frowned upon, no picking winners and losers, et cetera.

The Democrats have been a bit more activist; have supported a role in funding for applied research; have seen a potential role for the federal government in trying to address the valley of death, the lack of funding that comes after the research stage and when you are going into the prototyping and scale-up and pre-commercialization of technology, a clear role in technology development and emphasis on public-private partnerships as well as support for medium-sized enterprises. I think over the past 15 or 20 years there has been a growing recognition that with the globalization of R & D and globalization of the economy that nurturing indigenous companies that are small in the United States and trying to give them the opportunity to grow up and become big companies should be a critical element of what the United States policy.

When we came to the Clinton Administration, President Clinton, I think, as Kent mentioned, was the first president to affirmatively campaign with a technology policy during the campaign; he actually put out a document.³⁶ They had policy initiatives that were talked about at stump speeches, and the month or two after Clinton and Gore came into office, they actually released a formal technology policy early in 1993 that then followed up on those campaign promises.³⁷ They formed a cabinet level National Science and Technology Council.³⁸ The President took an interest in trying to have a balance in the research portfolio between civilian and defense investments. We were more heavily skewed toward defense investments at that point in time, and at that time, that's, of course, before the global war on terrorism and the war in Iraq, we were at a time when we thought we were at a peace dividend and having a more balanced civilian defense portfolio. The Clinton Administration, I think, also actively played with the notion of having a new federal government mission, which was competitiveness, and looking at whether or not some of the assets in the federal laboratories could be marshaled more

³⁶ David M. Hart, *Managing Technology Policy at the White House*, INVESTING IN INNOVATION: TOWARD A CONSENSUS STRATEGY FOR FEDERAL TECHNOLOGY POLICY, (1997), <http://www.ksg.harvard.edu/prg/hart/techwh.htm> (last visited Oct. 5, 2006).

³⁷ See generally Steve Lohr, *Lesson for a High-Tech President*, N.Y. TIMES, Jan. 24, 1993, at D2 (Explaining early Clinton administration position on technology and trade); see also John Carey, *The Clintonites' New Quagmire: Subsidies for High Tech*, BUS. WK., June 20, 1994, at 51 (Describing Clinton's formal technology policy and follow up on campaign promises).

³⁸ Exec. Order No. 12,881, 58 Fed. Reg. 226 (Nov. 23, 1993), available at <http://www.archives.gov/federal-register/executive-orders/pdf/12881.pdf>.

effectively to have a more direct impact on industrial R & D. Because of the political climate, that idea never went anywhere. There were a couple of years at the beginning of the Administration where there was a lot more emphasis on partnering, a lot more openness, and then political conflicts started to happen. And people kind of all over the agencies crept back more into their traditional roles after a couple of years.

We also focused in the mid '90s on innovation friendly business climate issues, such as the R & D tax credit.³⁹ That's a perennial subject of debate in Washington, further reduction of antitrust barriers, trade pacts like NAFTA and GATT, export control reduction, and also smaller issues that people felt had a significant impact on innovation such as class action lawsuits and stock option issues and the impact that that had on being able to hire talent into these companies. The ability to innovate and bring products and services to market quickly were all looked at.

One of the most interesting aspects of the Clinton Administration policy was a real embracing of the importance of investing in public-private partnerships as well as catalyzing partnerships between private sector companies, both small and large, on R & D projects with the potential for large economic benefits. That's what the Advanced Technology Program (ATP) does, and that became highly controversial, as some here in the United States, and perhaps in Canada, may already have heard.⁴⁰ This was actually a program piloted in the early '90s under George H. W. Bush's Administration,⁴¹ and the Clinton Administration was planning to expand this program to a national program of about a billion dollars a year.⁴² Because of political resistance to it, we actually are at a point today where the program, I think this year, has

³⁹ See Interview by CNN Anchor Kelly Arena with Cecilia Adams, US Chamber of Commerce (Sept. 23, 1998) (Describing Clinton focus on the R & D tax credit).

⁴⁰ See generally Deborah Shapley, *American R & D Rich in Paradox – Innovations Multiply as Research Stagnates*, FIN. TIMES, Aug. 16, 1994, at 12 (Describing potential problems in Clinton's industry-government 'partnerships' because they are too small-scale and the dollars firms are using to match federal funds takes money away from other projects); see also Charles M. Sennott, *\$150 Billion Dollar Welfare Recipients: US Corporations*, BOSTON GLOBE, July 7, 1996, at 1 (Discussing aid given to corporations, while ordinary Americans struggle to make ends meet).

⁴¹ See generally George C. Lodge, *It's Time for an American Perestroika*, ATLANTIC MONTHLY, Apr., 1989, at 35 (Discussing Sematech, a public-private partnership in the semiconductor industry in the mid to late 1980s); see also The Freedom Support Act of 1992, Pub. L. No. 102-511, 106 Stat. 3320 (1992) (Authorizing the establishment of a civilian research and development foundation to encourage bilateral research between Soviet and American scientists after the Cold War).

⁴² See generally John Markoff, *U.S. Planning to Expand Tax Credit for Research*, N.Y. TIMES, Jan. 29, 1998 (Describing Clinton / Gore plans to double amount spent on Advanced Technology Program between 1998 and 2003).

been formally eliminated, finally, in the budget,⁴³ after many years of up and down budgets and a lot of legislative fights.

But fundamentally the debate over ATP is important because the debate is fundamentally: what's the role of the federal government in supporting research? And what was interesting about this program is that it went beyond funding for basic research, and it attempted to make investments in high risk, high payoff technologies that would have broad based economic benefits to the United States. ATP really was a catalyst for forming partnerships among small companies, as well as between small and large companies.⁴⁴ And that was probably what got it a little bit into some of the political trouble because people on Capitol Hill would say why are you paying IBM to make an investment? They can afford to make the investment, and one of my bosses who was a feisty 65 year-old lady, who was the former R & D chairman at Allied Signal, she would always say, "Of course, IBM can afford to make the investment; I want them to make it here, not China." And that kind of thinking is something I think we in the United States are going to have to grapple with. As we deal with all of these global corporations, some with United States flags, some not, that can invest anywhere in the world, we may have to think about becoming more aggressive, about creating incentives for people to invest in the United States, not just with investments elsewhere. The Manufacturing Extension Partnership (MEP) is a program that provides appropriate technology for manufacturing companies.⁴⁵ That has kind of limped along over the years; I still think it fills an important niche.

On the infrastructure side, some of the critical programs that the Clinton Administration worked on were all of the work around the internet, e-commerce policy, and national innovation infrastructure. It was a real effort to attack the digital divide in what was perceived in the '90s as unequal access to both internet access, and then over time, to look more at access to broadband, as being a critical component; there were a number of programs that were dedicated to meeting those goals.⁴⁶ On the work force side, obvi-

⁴³ *Domestic Programs Take the Hit; Budget Would Increase Security Spending but Cut or Curb 141 Programs*, WASH. POST, Feb. 7, 2006, at A19.

⁴⁴ See generally Eric A. Benhamou, *R & D Needs Washington's Support*, WALL ST. J., June 17, 1999, at A26 (Describing previous high risk, high payoff technologies supported by government research including recombinant DNA technology and the internet); see also *Sematech was meant to revitalize American chip making. Did this model for a new technology policy deliver the goods?*, THE ECONOMIST, Apr. 2, 1994, at 77 (Explaining how industry – government partnerships acted as a catalyst in forming partnerships between companies in the semiconductor industry).

⁴⁵ See Editorial, *Spending That's Really Investment*, WASH. POST, Apr. 12, 1993, at A18 (Describing how the manufacturing extension partnership helps small to medium-sized manufacturers learn new techniques to help their businesses become more efficient).

⁴⁶ See, e.g., Benny Evangelista, *Helping Kids Go From the Mean Streets to the Information Superhighway*, S.F. CHRONICLE, July 5, 1999 (Describing Clinton plans to open Acad-

ously the quality of the science and engineering work force has been a long-term concern in the United States, as well as the overall educational system. There were a number of programs in the Clinton Administration that sought to address the opportunity for more and more Americans to attend college,⁴⁷ so there was a whole lot of emphasis around scholarship programs, lifelong learning tax credits, and those kinds of things. There was also some attempt to tackle the Work Force Investment Act kinds of programs,⁴⁸ which are fundamentally what the labor department was running for 20 or 30 years,⁴⁹ and it is a whole portfolio of programs that helps workers get retraining when they have lost their job.⁵⁰ That whole infrastructure was and to some extent still is - in the United States - focused around traditional industrial and manufacturing jobs. So there was some recognition in the '90s of the need to bring those policy frameworks and programs into a more modern focus. In addition, the Clinton Administration embraced a number of programs to promote technical literacy in math and science education.⁵¹

Now, moving on to the Bush Administration, I think all of the same, many of the same elements that the Clinton Administration was focusing on have remained in effect. I would say in the business climate arena, the focus has been mostly on tax cuts; R & D tax credits still is a big issue.⁵² Legal and

emies of Information Technology across the country to offer programs to train high school students for careers in the computer industry).

⁴⁷ See generally THE WHITE HOUSE, EDUCATION PAGE: SUPPORTING QUALITY EDUCATION FOR ALL CHILDREN, <http://clinton4.nara.gov/WH/Accomplishments/education.html> (2000) (Describing Clinton / Gore attempts to improve college enrollment rates through HOPE Scholarships, expanding work study and Pell Grants and making student loans more affordable).

⁴⁸ See Brian Meyer, *Private Industry Council Staff to Assist New Training*, BUFFALO NEWS, May 10, 2005 (Explaining how the Workforce Investment Act of 1998 gives economically disadvantaged workers the opportunity to choose from a variety of training options).

⁴⁹ See, e.g., President Lyndon B. Johnson, Remarks at the University of Michigan (May 22, 1964), available at <http://www.lbjlib.utexas.edu/johnson/archives.hom/speeches.hom/640522.asp> (Outlining his plans to build the Great Society and his goal to bring increased education to the urban poor to advance job opportunities).

⁵⁰ See, e.g., Workforce Investment Act, 20 U.S.C. § 9201 (1998) (Describing purpose of act to assist adults in educational training in order to obtain employment and self sufficiency).

⁵¹ See generally President Bill Clinton, Address at Springbrook High School, Silver Spring, Maryland (Mar. 16, 1998) available at <http://www.ed.gov/inits/Math/timsroun.html> (explaining importance and administration goal of implementing competency tests for high school teachers in the fields of science and mathematics).

⁵² See generally Press Release, White House, President Signs Energy Policy Act (Aug. 8, 2005), <http://www.whitehouse.gov/news/releases/2005/08/20050808-6.html> (Explaining the need for tax credits to give incentives to diversify our natural resources); but see Joel Have- man & Richard Simon, *Prospect's Bright for Bush's Competitiveness Plan*, L.A. TIMES, Feb. 12, 2006, at A26 (Describing President Bush's desire to close the Advanced Technology Program as part of his Anti-Competitiveness Initiative).

tort reform and healthcare reform have really moved to the fore.⁵³ When you start reading articles about how every car that is manufactured in the United States carries with it a \$1,500 price tag to pay for healthcare, that is a significant competitiveness issue that companies are going to have to deal with in the United States.⁵⁴ In addition, the Bush Administration, I think, has made some progress on funding for basic research in the physical sciences, mathematics, and engineering.⁵⁵ That was an area, as Kent mentioned, that had been lagging in funding, and lagging behind in inflation badly over a 20 to 30-year period, and some of the new initiatives put forth in the president's American Competitiveness Initiative seek to address that.⁵⁶ The Bush Administration has also worked hard to expand Homeland Security R & D. The Homeland Security Department was created initially by absorbing work that was coming out of other departments, so there was not a lot of new investment for the first couple of years, but over time there has been some investment added. At this time, there is really some new investment around Homeland R & D.

The hydrogen initiative and Freedom Car,⁵⁷ I think David mentioned this morning, I think is an extremely important initiative to really see if it is possible to develop transportation and stationary applications in fuel cells.⁵⁸ There are an enormous number of barriers to commercialization of fuel cell technology, however. And if this is going to come about, a Government role in helping overcome the barriers, as well as funding some of the research, is going to be important. It is about \$2 billion dollars, a billion per year and \$5 billion to \$7 billion over five years roughly, and I think that a lot more investment could be put into those kinds of projects.⁵⁹ As Kent mentioned, energy is a huge challenge for the future, and has the potential to be kind of a man on the moon organizing effort that people can really get behind, new

⁵³ Press Release, White House, President Calls for Medical Liability Reform (Jan. 16, 2003), <http://www.whitehouse.gov/news/releases/2003/01/20030116.html>.

⁵⁴ See Rick Wagoner, Editorial, *A Portrait of My Industry*, WALL ST. J., Dec. 6, 2005, at A20 (Describing how GM spent \$5.2 billion on health care in 2005, or \$1,525 for every car or truck produced).

⁵⁵ See generally Mark LaPedus & George Leopold, Updated: Bush to Boost Research Funding, EE Times Online, Jan. 31, 2006, <http://www.eetimes.com/news/latest/showArticle.jhtml?articleID=177105899> (discussing various initiatives of the Bush administration relating to increases in research funding).

⁵⁶ See generally President's Letter, AMERICAN COMPETITIVENESS INITIATIVE (Feb. 2, 2006) at 3, available at <http://www.whitehouse.gov/stateoftheunion/2006/aci/aci06-booklet.pdf>.

⁵⁷ See generally Press Release, The White House, Hydrogen Fuel Initiative Can Make "Fundamental Difference" (Feb. 6, 2003), <http://www.whitehouse.gov/news/releases/2003/02/20030206-12.html>.

⁵⁸ *Id.*

⁵⁹ *But cf.* Press Release, The White House, Fact Sheet: Hydrogen Fuel: a Clean and Secure Energy Future (Feb. 6, 2003), <http://www.whitehouse.gov/news/releases/2003/02/20030206-2.html>.

students in science and engineering can get passionate about, that research agendas can follow and may have some of the effects that we saw during the '60s with the space program, as well as overcoming the climate and fuel challenges that we are going to be facing, that we already are facing.

As I mentioned, one of the other things the Bush Administration has done is pulled back on some of the notions about investing in applied research, so the Advanced Technology Program has been eliminated just recently successfully,⁶⁰ and support for the MEP has been scaled back.⁶¹ In the area of infrastructure, healthcare information technology has been an enormous area of focus, looking at the enormous amount of healthcare dollars that are eaten up by people using different information systems,⁶² by using paper forms when you can have a medical record that you could carry around with you, on a card, or on a thumb drive. And I give the Bush Administration a lot of credit for actually putting a lot of thinking and funding behind trying experimental approaches to try to get some very good information technology working in healthcare. They also have worked a whole lot on the issue of freeing up more spectrum. The federal government controls an enormous amount of spectrum, and it is causing a lot of problems now because we don't have adequate spectrum for Homeland Security applications and for really innovative products and services that require spectrum; the Administration has been putting a lot of emphasis on that.⁶³

On the work force issues, a lot of the Administration's emphasis comes from the President's competitiveness initiative. However, many of the proposals were really things that the Administration was already focusing on, that then were taken and kind of highlighted when the President did his State of the Union speech. The Community college initiative provides a whole lot of additional funding for community colleges and emphasizes training 70,000 teachers for advance placement, math and science programs, creating a teacher core of 30,000 math and science professionals,⁶⁴ as a parent of a

⁶⁰ *Contra* THE WHITE HOUSE, OFFICE OF MANAGEMENT AND BUDGET, DETAILED INFORMATION ON THE ADVANCED TECHNOLOGY PROGRAM ASSESSMENT (Aug. 3, 2006), <http://www.whitehouse.gov/omb/expectmore/detail.10000030.2005.html> (though the Bush Administration attempted to remove its funding, the ATP received \$79 million in FY 2006, but no funding is scheduled as of yet for FY 2007).

⁶¹ *See generally* AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, 2006 BUDGET CUTS NOAA AND NIST R&D, ELIMINATES ATP (Mar. 9, 2005), <http://www.aaas.org/spp/rd/doc06p.pdf#search=%22MEP%20budget%202006%20cuts%22>.

⁶² *See generally* Press Release, The White House, President Bush Touts Benefits of Health Care Information Technology (Apr. 27, 2004) <http://www.whitehouse.gov/news/releases/2004/04/20040427-5.html>.

⁶³ *See* Press Release, The White House, Presidential Memo on Spectrum Policy (June 5, 2003), <http://www.whitehouse.gov/news/releases/2003/06/20030605-4.html>.

⁶⁴ *See* THE WHITE HOUSE, STATE OF THE UNION, AMERICAN COMPETITIVENESS INITIATIVE: LEADING THE WORLD IN TALENT AND CREATIVITY (Feb. 2, 2006), *available at*

child in public school is very important. Most K through 6/K through 10 students, in the United States, are taught by their football coach or their reading teacher and not by people who are math and science professionals. The Math and Science Partnerships program seeks to improve K-12 math and science. Actually, there is a version run by the National Science Foundation⁶⁵ as well as one that is run by the education department,⁶⁶ two different approaches toward urging states and locals to create partnerships for improvement of math and science teaching and education.

Immigration reform, I guess my comments on that is that most of the debate in Washington centers around the need to address the issue of low skilled workers,⁶⁷ and I would like to see more of the debate be balanced around opportunities for highly-skilled workers to enter the United States. I think that part of the United States immigration policy is also broken and out of sync with the needs of the 21st century.

Very briefly, a couple of challenges that I think we in the United States have not really grasped yet, I think we have not gotten our arms around despite a lot of rhetoric in Washington. The good news is that competitiveness is at the top of everyone's agenda. The President has come forward with this American Competitiveness Initiative. The Democrats on the Hill have their competitiveness plan. The Republicans have their competitiveness plan. There are two or three pieces of bipartisan legislation addressing different components of these challenges. However, despite all that activity, I am not sure that we have really grasped what it means to be in a completely globalized economy with a globalized talent base, with a globalized R & D, with a globalized sourcing and the kinds of off-shoring that are going on. And importantly, I don't think that we have grasped the whole set of challenges that relate to the un-tethering of U.S. multinationals and U.S. national interest. The old saying *what's good for GM is good for the nation*, is not true the way that it was many years ago. Does GM or Toyota provide ore economic advantages to the nation? We haven't looked at any of those issues, and many of our policies and programs are designed around two theories: One is United States superiority. We have this whole set of export control laws that assumes the United States always has the best; that we have to protect it, both for national security reasons and for competitiveness reasons. In a globalized

<http://www.whitehouse.gov/stateoftheunion/2006/aci/#section5>.

⁶⁵ See NATIONAL SCIENCE FOUNDATION, MATH AND SCIENCE PARTNERSHIP, available at http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5756&org=EHR (last visited Oct. 4, 2006).

⁶⁶ See U.S. DEPT. OF EDUC., MATHEMATICS AND SCIENCE PARTNERSHIPS, <http://www.ed.gov/programs/mathsci/index.html>.

⁶⁷ See generally Knowledge @ Wharton, Law and Public Policy, *The Immigration Debate: Its Impact on Workers, Wages and Employers* (May 17, 2006), <http://knowledge.wharton.upenn.edu/article.cfm?articleid=1482&CFID=2162490&CFTOKEN=89988859>.

economy, that makes less and less sense, and we ought to be looking at areas where we can actually learn from research and work going on in other countries, and I don't think we are very well equipped to do that at this point.

In addition, we have this whole set of regulatory regimes and requirements that are based on the belief that U.S. companies providing maximum benefits to the United States. In addition, we have to grapple with the societal and ethical implications of some of the new kinds of technologies that are coming down the road such as nanotechnology and stem cell research. We have to address our education challenges, and we have to move beyond our traditional ways of thinking. That's why I go back to the point; we still are investing on the Vannevar Bush model, even though we have done many things over the years to address some of these issues and challenges. But the new part of our portfolio is less than 25 percent of what the United States government invests, and I think that here we are at the beginning, relatively the beginning of a new century, and it really is time to embrace those challenges. And it is my hope that the next president, whoever he or she is, will take that on as a challenge and will fundamentally reassess what the United States is doing as we go forward into the 21st century.

Thank you very much.

DISCUSSION FOLLOWING THE REMARKS OF THOMAS BRZUSTOWSKI AND THE HONORABLE KELLY H. CARNES

MR. SISTO: Thank you, Kelly; a very, very good and thorough review of the current state and a few comments regarding the future. What I did not mention, when I mentioned the students I was with, is that the majority of them are IT candidates, who have had early and intensive exposure to math and science; so, I do think that, hopefully, if we continue in that trend of introducing them at an intensive stage and earlier stage in their schooling, we will have more U.S. students coming out with an interest in math and science as a career.

My question is to lead off – is that all right, Mr. Chairman? May I ask a leadoff question?

DR. KING: I have a question.

MR. SISTO: I guess I can't. Do you need a microphone?

DR. KING: Yeah. How do you equate the transfer of U.S. research overseas to these other countries with our own self-interest or national policy? Should there be some restrictions on it? Are there limitations? Does it benefit the U.S. economy?

In other words, I see research jobs going overseas. Those jobs could have been done here. What's the effect – what's your view on that?

HON. KELLY CARNES: Since this is a United States question, I will dive in.