**The National Nanotechnology Investment: Manufacturing, Commercialization, and Job Creation**

Testimony of
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Chairman Nelson, Arkansas Senator Boozman, and Members of the Committee,

I appreciate the opportunity to testify today about the developing impact of nanotechnology and the role of federal support in maintaining U.S. leadership in this field. While my brief remarks will focus on research, education, and commercialization at Rice University, when combined with the testimony of colleagues, I hope you will see a picture of the vibrancy and future impact of this critical field.

My name is George McLendon. I am the Howard H. Hughes Provost and Professor of Chemistry at Rice University in Houston, Texas. I have published hundreds of articles and hold a number of commercialized patents in areas ranging from nanotechnology to oncology. I am committed to insuring that the fruits of federally funded research translate into commercial products that create jobs at home, and improve lives in the U.S. and worldwide.

In my brief remarks, I will highlight three examples of work from Rice University Smalley Institute for Nanoscale Science and Research. The Smalley Institute is named in honor of the late Richard Smalley, who received the Nobel Prize for the discovery (at Rice) of the buckminsterfullerene (a.k.a. $C_{60}$, a.k.a. "buckyball"). The Smalley Institute was the first university research institute devoted to nanoscience and nanotechnology, and is ranked among the world's best. We draw together colleagues independently from (15) different departments at Rice, alongside scientists from industries both large and small. The Institute also spawned CBEN, which pioneered investigation of biological and environmental implications of nanotechnology bringing state of the art research to stakeholders from industry to the Environmental Defense Fund. We are also deeply committed to translation of basic research to sustainable commercial practice, which allows such research to benefit the citizens who have supported it.

Nanotechnology is a foundational technology that can create hundreds of thousands of new jobs to make new products and my colleagues help create… According to a presentation by Clayton Teague, former Director of the Federal National Nanotechnology Initiative, the nanotechnology industry currently employs over 150,000 Americans and that number is expected to grow significantly. It is estimated that there could be as many as 800,000 jobs in nanotechnology by 2015. Nanotechnology can be the major driver of economic growth over the next two decades. The U.S. needs to make important decisions now to ensure that this growth occurs in the United States where it can be of greatest benefit to U.S. citizens who provided the resources to fund this technology.

Rice does this in several ways. First, we have formed direct partnerships with major corporations (e.g. Lockheed Advanced Nanotechnology Center at Rice—LANCER), which performs basic research in support of the technology challenges posed by the state of the art (defense) technologies needed by Lockheed Martin. In the course of such research partnership, we have also educated over 200 Lockheed scientists in the basics of nanotechnology via targeted courses.

This highlights a critical role of universities in sustaining U.S. leadership in nanotechnology: the education of the next generation of leaders.

A second example addresses the U.S. need for energy independence. The Advanced Energy Consortium (AEC) includes ten major energy companies who support work on nanotechnology which helps increase domestic production of hydrocarbon resources, with decreased environmental impact: "greener carbon," which ranges from "down hole" sensing, to advanced drilling technologies to mitigate environmental impacts of hydrocarbon production, to remediation of water which may be affected by energy production.

Two specific examples may be germane. Professor Andrew Barron has developed "green muds" which enhance efficiency of oil by combining nano particles into drilling fluids. This technology has spun out into an independent company, which is currently producing and selling these advanced materials for conventional and unconventional enhanced recovery.

A personal favorite example lies at the interface of chemistry and environmental science. Two of my colleagues, chemist Vicki Colvin and engineer Pedro Alvarez, are developing nanotechnologies to cheaply and safely remediate water pollution. For example in Guanajuato, Mexico much well water is hazardous, because of high local arsenic levels. Colvin and Alvarez showed how "rust" nanoparticles could cheaply, safely and effectively remove the arsenic to safe levels, making safe local drinking water available for the first time for many people. Similar approaches can remediate water, which has come in contact with other pollutants.

Similar stories emerge in health care. My colleague on this panel Professor Mirkin, pioneered nanodiagnostics. Similar approaches have been further developed and engineered by my Rice colleague, John McDevitt, to produce "labs on a chip." Technologies which allow point of care diagnostics from AIDS tests to drug screening at a fraction of current costs, and in ways that fully integrate health care with IT with huge potential. These novel technologies are being commercialized by a privately funded start-up, Force Diagnostics. The next generation of such technologies will depend on federal private partnerships to reach their full potential.

A second example draws from my own interest in oncology. Rice colleagues Jennifer West and Naomi Halas have used nanochemistry to engineer nanoparticles, which absorb light to which our bodies are transparent. This absorbed light heats the particles and destroys nearby tumors. These inventions have also spurred venture funding of a novel start up, and clinical trials are underway.

Rice has worked diligently in these areas to develop an "innovation ecosystem," combining state, federal and private funding for entrepreneurship. For example, in the life sciences, we are creating, in partnership with the state and private investors, a "think tank" accelerator which combines venture funding, successful entrepreneurs and entrepreneurs in training, CRO support and foundational and applied science and engineering to serve the Texas Medical Center, the world's largest research medical center.

Federal support for fundamental science is the critical first step in such partnerships, which, as noted, can translate these fundamental discoveries to commercial practice to provide sustainable social benefits.

I have given only a few examples of many extraordinary advances in science and technology developed at Rice. These illustrate an approach in which initial government funding is highly leveraged again and again by private sector investment to produce new products and services that transform lives, whether in creating new energy resources or safer drinking water.

To achieve such goals, the National Nanotechnology Initiative (NNI) should be reauthorized to help guide the translation of basic research to commercial practice. Currently, the NNI budget supports nanoscale science, engineering, and technology research and development (R&D) at 15 agencies with 10 additional participating agencies.  NNI helps to align these agencies so that they can work in a coordinated way to move this technology from discovery to commercialization.  A new reauthorization will allow the Federal Government, universities, and the private sector to work to find creative ways to bring these promising technologies to the market more quickly and economically.  In the absence of reauthorization, these agencies will be focused in different directions and the industry will struggle to transition into the next stage while other countries continue to close the existing gap.