TESTIMONY

OF

NORMAN R. AUGUSTINE

OF THE

AMERICAN ENERGY INNOVATION COUNCIL

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES

OF THE

UNITED STATES SENATE

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Mr. Chairman and members of the Committee, thank you for this opportunity to share with you some thoughts on the challenge of providing safe, clean, affordable energy in sufficient amounts to power our nation in the years ahead.

My remarks today will be based upon the work of the American Energy Innovation Council, an independent and informal group of seven members who came together because of our common concern over what we consider to be America's insufficient response to one of the greater challenges facing our nation today; namely, the provision of energy. In this capacity we represent no other group. We speak simply as seven citizens who in the course of our careers have been called upon to meet various challenges and would like to share that experience as it relates to the energy challenge.

My colleagues in this endeavor are Ursula Burns, chairman and CEO of Xerox; John Doer, partner at Kleiner Perkins Caufield & Byers; Bill Gates, chairman and former CEO of Microsoft; Charles Holliday, chairman of Bank of America and former chairman and CEO of DuPont; Jeff Immelt, chairman and CEO of GE; and Tim Solso, chairman and CEO of Cummins, Inc.

Our work has been provided administrative and technical support by the Bipartisan Policy Council (of which I am a director). The Bipartisan Policy Council was founded by Senators Howard Baker, Tom Daschle, Bob Dole and George Mitchell as a non-profit organization seeking principled solutions to difficult public issues through analysis and respectful dialogue.

Your committee is well aware of the extent to which energy issues permeate of the challenges faced by our nation. These include the impact the uncertain availability and cost of energy has on our economy; the hazards of energy-related pollution on our planet's natural environment; and the role of constrained and manipulated energy supplies as a source of armed conflict. Thus, while fully recognizing the overall demands facing America today, the provision of safe, clean, affordable and sustainable energy is, by virtually any standard, one of the foremost challenges, particularly given its high leverage upon solutions to other problems.

While my testimony today is drawn from the work of the American Energy Innovation Council and while I am honored to have been invited by the Committee to appear before you, as in the case for all our members, I have no special authority to speak for the group as a whole. I do, however, believe that my testimony represents the general views of my colleagues.

Among its activities to date the Council has issued two reports. The first of these highlighted the need for a more vigorous public commitment to energy technology development. America's investment in energy innovation from the public and private sectors together is less than one-half of one percent of the nation's energy bill. This fraction is eclipsed by the innovation investment in most other sectors, particularly those in the high-tech arena. Meanwhile, we send one billion dollars abroad each day to pay our energy bill to foreign producers.

The Council's second report addressed the limited but important role the federal government will need to play in catalyzing American ingenuity as it seeks to meet the energy demands of the future.

While most of the current means of energy production are likely to be with us for a long time, each suffers from one or more shortcomings, whether it be cost, pollution, hazardous by-products, safety, limited scalability, or lack of domestic sources. If these liabilities are to be overcome the nation will need to depend more heavily on innovation; that is, utilize high quality research to create new knowledge, world-class engineering to convert that knowledge into new energy sources and delivery means, and enlightened entrepreneurship to translate those sources and delivery means into the marketplace. Fortunately, America has excelled in all three of these activities, which together make up innovation—although it should be noted that we are now losing our lead in at least two of these attributes.

In pursuing this process it is not uncommon to encounter what many innovators refer to as "The Valley of Death"—that period where an idea appears promising but has not yet been demonstrably shown to be workable in practice—and therefore is deemed too risky by most investors. To surmount the latter generally requires some form of convincing proof-of-principle demonstration…which in turn requires financial resources—thus the dilemma.

In many of the potential avenues for providing large quantities of energy there is also a second "Valley of Death." This latter valley is the gap that spans from proof-of-principle using, say, a prototype, to verification of market utility, including economic viability, with a near commercial-scale demonstrator. The latter valley, which also deters investors from participating, is a consequence of the characteristic that the steps in the process of developing new forms of energy often come in large quanta, making it very expensive to remove uncertainties as to ultimate scalability of an otherwise promising project.

Further complicating energy innovation is the capital intensiveness of most forms of energy production, delivery and storage, a characteristic that makes the economic threshold for replacing old plants with new ones very high.

In short, due to the risk entailed, private sector investment will often be unavailable to assist in crossing either of these important developmental gaps. In the case of basic research, market payoffs are usually well over a decade in the future, and may not exist at all. In the case of proving scalability, the size of the investment required is often large and the results uncertain. But in spite of these considerations, the development of new energy sources remains of critical importance to the nation…hence means of overcoming them must be found.

Although I must confess that I, and I believe my colleagues, are strong devotees of free enterprise as opposed to government involvement in markets to the extent

practicable, the energy dilemma seems to be exactly the sort of issue which governments are designed to help solve, at least in democracies with free enterprise markets. That is, this is a case wherein there is an important benefit to be had by the citizenry as a whole but private resources cannot, or will not, provide that benefit because of financial risk, extensive delays in receiving returns, small or even negative returns and the possibility that the returns will not even accrue to the investor or performer. The latter is particularly true in the pursuit of basic research.

This circumstance is one that has long been recognized by our government in a number of areas, including many involving the application of technology. Commercial nuclear power was the result of government investments in Naval reactors; commercial jet aircraft trace their origin to military transports; GPS to military positioning systems; the internet to packet-switched networks demonstrated by ARPA; and communication and weather satellites to military space programs. These achievements were in some cases by-products of the government's pursing other missions in the interest of its citizens—but the provision of energy is itself a mission of the utmost importance to the citizenry.

Looking further back in time there was the creation of land-grant colleges, agricultural research institutes, the federal highway program, and the air traffic control system. The key point is that the government advanced the state of the art in these areas to a point at which the private sector could responsibly undertake implementation and operation of the capability sought by the citizenry.

Principal objections to greater government participation in, and particularly in funding of, such developments are that (1) government involvement may favor one private entity over another, (2) foreign firms, not U.S. firms, may prove to be the ultimate beneficiary of the U.S. taxpayers' investments, (3) the government should not be in the business of "picking winners and losers," and (4) there are other important demands for the application of the government's financial resources.

In fact, the government's work in the early research phase can be, and generally is, made available to all interested parties…much as, say, NASA does with its aeronautics research. In the case of funding scalability demonstrations, the solution resides in maintaining fair and open competition. With respect to foreign firms being the principal beneficiaries, it is simply a fact of life in the globalized marketplace, permeated with instant communications, that the only way to prosper is to be quicker to the market with a better overall product that one's competitors…not to hope to hide information. With regard to picking "winners and losers," the government in effect does this every day at DARPA, ARPA-E, NSF, NIH, and elsewhere. The key to success under this circumstance is to maintain competition for ideas, transparency of results, and competent government employees who can weigh the options that are available—once having considered the private sector's perspective. Without these three ingredients failure will be assured irrespective of what foreign competitors might or might not choose to do. Finally, with regard to the other funding demands faced by the government, few issues

have greater potential adverse impact on our nation than the availability of clean, affordable energy.

One technological development that has only recent occurred has the potential to profoundly impact the possibility of applying innovation across the energy spectrum. This is the marriage of horizontal drilling and hydraulic fracking to free trapped shale gas. This can provide America with the opportunity, if appropriately executed, to greatly reduce dependency upon foreign sources for its energy in the relatively near future and for many decades into the future…thereby providing the time needed to develop other energy sources including what may be the "ultimate" solution to the energy challenge, nuclear fusion. But the latter is yet another example of something that will never occur if we must wait for private investors to fund the needed research and development or if the government elects to under-invest in the relevant technology.

The members of the American Energy Innovation Council are aware of the intense fiscal problems facing the nation—and you as its leaders. But we are also aware that in our own business responsibilities that during difficult times it may be necessary and appropriate to *increase* spending in some areas while at the same time making overall reductions. There is an important distinction to be made between investment and spending for consumption.

Whatever the case, it is important to recognize that not all investments in innovation will "pay off"…some, perhaps most, will fail. This is simply a fact of life. Supporting innovation is neither a short-term strategy nor a pursuit for the uncommitted.

Finally, it would be inappropriate for me to miss this opportunity to address briefly the precarious position in which America's overall innovation engine finds itself today…not just as it concerns energy needs but as it affects virtually all national issues. Our graduate schools of engineering now train mostly foreign engineers who increasingly say they will be returning home; our public primary and secondary schools are, on average, among the worst in the world; our great public research universities are challenged as never before by steep reductions in their funding; the consumer market is moving to the developing nations; our debt is so immense that it makes investment in the future particularly challenging; our corporate tax rates are now the highest in the world; our patent system is antiquated, as are our export controls and visa-granting systems; and U.S. corporations spend over twice as much on litigation as on research. This is not a formula for sustaining the success we have enjoyed in the past.

Fortunately, America still has a great deal remaining on the asset side, including high quality, albeit endangered, research universities; a culture of innovation and risk taking; the rule of law; the sanctity of contracts; use of the English language; and more. But today's trends are not in our favor, and when one considers the rapidity of advancement in technology it is apparent that a nation can lose its position in a technology driven, innovative economy very quickly. This has consequences that span from national security to health care and from the standard of living to the preservation of

our planet's environment. The energy challenge we face today is, in my judgment, merely a reflection of this much broader challenge.

Thank you very much for the opportunity to share these rather candid thoughts with you.

NORMAN R. AUGUSTINE was raised in Colorado and attended Princeton University where he graduated with a BSE in Aeronautical Engineering, magna cum laude, and an MSE. He was elected to Phi Beta Kappa, Tau Beta Pi and Sigma Xi.

In 1958 he joined the Douglas Aircraft Company in California where he worked as a Research Engineer, Program Manager and Chief Engineer. Beginning in 1965, he served in the Office of the Secretary of Defense as Assistant Director of Defense Research and Engineering. He joined LTV Missiles and Space Company in 1970, serving as Vice President, Advanced Programs and Marketing. In 1973 he returned to the government as Assistant Secretary of the Army and in 1975 became Under Secretary of the Army, and later Acting Secretary of the Army. Joining Martin Marietta Corporation in 1977 as Vice President of Technical Operations, he was elected as CEO in 1987 and chairman in 1988, having previously been President and COO. He served as president of Lockheed Martin Corporation upon the formation of that company in 1995, and became CEO later that year. He retired as chairman and CEO of Lockheed Martin in August 1997, at which time he became a Lecturer with the Rank of Professor on the faculty of Princeton University where he served until July 1999.

Mr. Augustine was Chairman and Principal Officer of the American Red Cross for nine years, Chairman of the Council of the National Academy of Engineering, President and Chairman of the Association of the United States Army, Chairman of the Aerospace Industries Association, and Chairman of the Defense Science Board. He is a former President of the American Institute of Aeronautics and Astronautics and the Boy Scouts of America. He is a former member of the Board of Directors of ConocoPhillips, Black & Decker, Proctor & Gamble and Lockheed Martin, and was a member of the Board of Trustees of Colonial Williamsburg. He is a Regent of the University System of Maryland, Trustee Emeritus of Johns Hopkins and a former member of the Board of Trustees of Princeton and MIT. He is a member of the Advisory Board of the Department of Homeland Security and the Department of Energy, was a member of the Hart/Rudman Commission on National Security, and served for 16 years on the President's Council of Advisors on Science and Technology. He is a member of the American Philosophical Society, the National Academy of Sciences and the Council on Foreign Relations, and is a Fellow of the National Academy of Arts and Sciences and the Explorers Club.

Mr. Augustine has been presented the National Medal of Technology by the President of the United States and received the Joint Chiefs of Staff Distinguished Public Service Award. He has five times received the Department of Defense's highest civilian decoration, the Distinguished Service Medal. He is co-author of *The Defense Revolution* and *Shakespeare in Charge* and author of *Augustine's Laws* and *Augustine's Travels*. He holds 29 honorary degrees and was selected by Who's Who in America and the Library of Congress as one of "Fifty Great Americans" on the occasion of Who's Who's fiftieth anniversary. He has traveled in 111 countries and stood on both the North and South Poles of the earth.