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**U.S. SENATE COMMITTEE ON ENERGY & NATURAL RESOURCES**

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*Priority Energy Issues*

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Chairman Bingaman, Senator Domenici, Members of the Committee, my name is John Deutch, and I am Institute Professor of Chemistry at the Massachusetts Institute of Technology. During the Carter administration I was Director of Energy Research, Acting Assistant Secretary for Energy Technology, and Undersecretary of the Department of Energy (DOE). During the first Clinton administration I was Undersecretary for Acquisition and Technology and Deputy Secretary of Defense, as well as Director of Central Intelligence. During President Reagan's administration I served as a member of the White House Science Council and during the second Clinton administration I served as a member of the President's Council on Science and Technology. Over the years I have served as a board member and/or a consultant for many energy companies, and as an advisor to government agencies and not-for-profit. I continue to do so. I teach a subject in physical chemistry and in energy technology at MIT and serve on MIT's energy council.

I first appeared before this committee over thirty years ago for my confirmation hearing to be Director of Energy Research. Senator Domenici was a member of the committee at that time, and it has been a privilege and a pleasure to work with him over the years. He has made tremendous contributions to this country and I hold him in the greatest respect and indeed with considerable affection.

Senator Domenici will remember, and perhaps some others here today, energy issues that were debated by Congress during the 1970s:

- Many different national energy plans:
  - President Nixon's 1973 *Project Independence* intended to make the United States independent from imported oil by 1985;
  - Vice President Rockefeller's 1975 proposal to create a \$100 billion (real money at that time) Energy Independence Authority to provide over a ten year period loans and guarantees to private companies to develop new domestic energy sources;
  - President Carter's 1978 National Energy Plan.
- Oil and natural gas price deregulation in 1977. An action acknowledging that market forces are more efficient than government regulation to allocate energy to users.
- President Carter's goal of 20% of all energy use from solar by the year 2000, announced in 1978.
- Creation of the Synthetic Fuels Corporation in 1979 for the purpose of demonstrating production of synthetic gas and liquids from coal and shale.
- Annual Congressional appropriations for research, development, and demonstration (RD&D), for a range of energy supply and conservation technologies, at expenditure levels significantly greater than today, in real terms.

Despite these and many other well-intentioned energy policy initiatives, the fact is that the United States has not been, and is not now, on a path to a secure and sustainable energy future. Although energy consumption per unit of gross domestic product is projected to continue to decline, due in large part to high projected prices, aggregate consumption of oil, natural gas, and coal is projected to increase. The DOE's Energy Information Administration estimates that oil imports, crude and products, will remain at high levels – about 60% of U.S. oil consumption – for the next two decades. In addition, North America is expected

to become a net importer of natural gas in the form of LNG. EIA projects, in its 2008 Annual Energy Outlook, that renewable sources of electricity capacity will grow from 10% in 2005 to 12% in 2030, while coal generating capacity will grow from 34% to 36%, during this same period. Total U.S. carbon dioxide emissions, mostly from coal-fired electricity generating plants, are expected to grow at an annual rate of 0.6%.

In sum, the U.S. economy is not meeting the three great energy challenges the country faces: (1) beginning the long and demanding transition away from a petroleum based economy; (2) reducing emissions of carbon dioxide and other greenhouse gases, in order to avoid the adverse consequences of global climate change, and (3) managing the foreign policy consequences of energy import dependence from politically unstable or unfriendly parts of the world, e.g., Iran, Venezuela, and Russia.

There are several reasons why it has proven so difficult for the United States to adopt and sustain a national energy policy: unrealistic goals, shifts in direction with each change in administration, difference among regional interests, strongly held views by different interest groups about technology winners, and vacillation in public attention as energy prices go up and down. But, in my judgment, the root cause is that our political leaders find it difficult to speak the truth about energy matters.

The public understandably wants affordable energy, free from foreign dependence and adverse environmental effects, but these objectives cannot be easily or quickly met. The reality is that progress will be slow because of the scale and magnitude of investment required, because of the need to invent and demonstrate new technology, and because of the need to adapt market structure and consumer preferences to new patterns of energy use. Moreover, the likelihood is that real energy prices – for electricity, home heating, motor and aviation gasoline – will continue, on average, to increase in real terms in the coming decades.

The sharp rise in oil prices has once again focused the public's attention on the urgency of providing for our energy future. If significant action is not taken today and sustained for several decades, we will, once again, run the risk that future generations of Americans will experience greater economic costs and dislocations, including conflict, than needs to be the case.

I offer seven priority actions that the country must take in order to be on a path to a sustainable future. The list is not a menu that offers choice; all these action and perhaps others, are required.

1. *Establish a charge for greenhouse gas emissions.* The Administration should propose and Congress should enact a charge for greenhouse gas emissions. The charge could be in the form of an emission tax or a cap-and-trade system with sale of emission permits. The charge should be set at a sufficiently high level, for example \$30 per tonne of CO<sub>2</sub> equivalent, so carbon free electricity generation, such as wind, geothermal, nuclear and coal with carbon capture and sequestration, is economic. Revenue from the charge should be allocated to (1) impact assistance for groups such as the needy and elderly that cannot afford higher electricity prices, (2) energy research, development, and demonstration, and (2) off-setting other existing taxes in order to reduce the macro-economic impact of the charge. With a comprehensive national program in place, industry will have a clear signal for their future energy infrastructure investments. Many existing burdensome regulatory mandates, such as state renewable portfolio standards, could be rolled-back, as part of a process to harmonize federal and state controls on greenhouse gas emissions..
2. *Establish an aggressive program to demonstrate carbon sequestration.* The new administration should propose, and Congress should enact, an a ten-year program for 3 to 5 sequestration demonstration projects, sequestering about 1 million tones of CO<sub>2</sub> per year, at a cost of about \$100 million per year per project (including the cost of CO<sub>2</sub>). The success of any effort to control greenhouse gas emissions in the United States depends on large scale

deployment of coal electricity generation with carbon capture and storage. The present pace of demonstrating the technical, economic, and environmental characteristics of this key technology and the construction of a regulatory framework that has public acceptance, is much too slow. These projects should proceed in coordination with a new national regulatory framework that establishes rules for site selection, monitoring, modeling, and verification of the sequestered CO<sub>2</sub>, and site liability after some period of operation. Consideration should be given to establishing a special purpose public-private corporation to execute the sequestration demonstration program in order to streamline the process of design, engineering, and project management.

3. *Improve the efficiency of energy use.* All experts agree that improving efficiency of energy use is a priority objective. Improvement in the U.S. economy's energy productivity as measured by gross domestic product per unit energy should be expected to continue, as consumers and industry adjust to higher real energy prices. A notable current example is the accelerating adoption of compact fluorescent to replace less efficient incandescent light bulbs.

However, the historical record of effectiveness of government efforts, at both the state and federal level, to improve energy efficiency is mixed. Energy efficiency standards for buildings, appliances, automobiles, (CAFE), and federal demonstration programs in the DOE, DOD, GSA, and other agencies have their role. But, the U.S. consumer and smaller private companies seem reluctant to make investments or change behavior and avoid choosing options that provide energy services at lower life-cycle cost. National and local regulation involving demand side management or other mandates have had limited effectiveness. We need to find a better way to spread best practice through the economy. I do not have an answer about how best to achieve this but we need to reproduce the success of the agricultural extension service in improving the productivity of U.S. farms in the first half of the 20<sup>th</sup> century.

4. *Accelerate energy innovation.* The current pattern of DOE research, development, and demonstration (RD&D) management is inadequate for the future energy innovation the country requires.

The past record of federal sponsorship – principally the DOE and its predecessor agencies – is not adequate to meet today’s challenges. Consider these shortcomings:

- A linear “technology driven” rather than “market” or application driven approach research development of demonstration of new technology;
- Little coordination between the R&D programs in various agencies: DOE, EPA, DOA, NSF, DOC, and others. For example, no five-year program budget exists for energy R&D across all involved government agencies;
- Reliance on traditional direct funding (and control) of R&D projects and episodic use of indirect incentives, such as guaranteed purchase, tax credits, loans;
- A mixed record on integrating private industry and government RD&D.
- Congressional influence out weighing technical merit in the selection of technologies and projects.

Consider the following suggestions for accelerating the federal effort in energy innovation:

- (1.) Create an inter-agency Energy Innovation Council to develop a multi-year National Energy RD&D strategy. The Council would have the authority and responsibility to plan, program, and budget energy and environment RD&D for all agencies.
- (2.) Increase the energy RD&D program budget to more than twice its current level.

- (3.) Launch a sustained and integrated energy R&D program in key areas, examples include: batteries and energy storage, cellulosic biomass, photovoltaics, gas separations. This effort should include basic research, as well as exploratory development, and involve universities, industry, and the DOE national laboratories.
- (4.) Create an energy technology career path within the civil service.
- (5.) Establish an Energy Technology Corporation (ETC) to manage demonstration projects. The purpose of the ETC is to establish the feasibility of new energy technology by demonstrating technical, economic, and environmental performance. Examples include: (a) Carbon capture and sequestration, (b) Gas To Liquids, (c) a smart electric distribution grid, (d) large scale cellulosic biomass production, (e) first-mover once-through nuclear power plants.

The record shows that DOE does not have the authorities or expertise to carry out successfully such demonstration projects. New technology deployment, which after all is the purpose of innovation, requires demonstration that is convincing to the private sector and to investors.

The purpose of the proposed ETC is different from the 1979 Synthetic Fuels Corporation. The Synthetic Fuels Corporation focused on production of synfuels, not technology demonstration, and thus was vulnerable to the bittersweet collapse in oil prices.

The technical demonstration projects proposed for the ETC are not based on price expectation but serious externalities like climate change and the long-term need to make the transition away from petroleum dependence.

5. *Expand domestic oil and gas production.* The United States should expand access to areas for oil and gas exploration – in Alaska, the Gulf Coast, and the east and west coasts. While the amount of environmentally responsible

incremental production will be modest compared to total oil and gas consumption, the increased production will slow the anticipated decline in domestic production. Importantly, any measures to expand domestic production will add credibility to United States efforts to encourage countries that possess resources to expand their production.

6. *Expand the use of commercial nuclear power.* Because nuclear power is essentially a carbon free source of electricity, it is highly desirable to expand its use. However, nuclear power faces three significant challenges. First, the cost of nuclear power generation is too high compared to coal in absence of a carbon charge. The impact of the recent increase in the cost of all large capital projects has been greater on nuclear power than other forms of generation. The assistance provided for a few new nuclear power plants in the 2005 Energy Policy Act is justifiable, provided that nuclear plants subsequently constructed are economic under commercial terms.

Greater progress is needed on radioactive waste management. The new administration and Congress would be wise to hedge successful licensing and completion of the Yucca Mountain underground spent fuel disposal facility by authorizing a new long-term program for away-from-reactor storage, with DOE taking custody of the spent fuel at federal facilities.

It is important that any expansion of nuclear power in the United States and other countries occurs without increasing the risk of nuclear weapons proliferation. President Bush and the G-8 have taken an important initiative that deserves bipartisan support: nuclear supplier states will offer front-end enrichment and back-end waste management services under attractive terms to countries who are new users of nuclear power, in order to prevent the spread of enrichment and reprocessing.

However, domestically, the Bush administration advocates a return to a “closed” fuel cycle, where spent reactor fuel from commercial reactors is reprocessed to produce mixed oxide fuel. This advanced fuel cycle initiative

has no justification at present. Developing the closed fuel cycle will require vast federal R&D expenses with dubious advantages for waste management compared to the “once-through” fuel cycle, when both short term and long term risk are considered. To be sure, at some time in the future, if nuclear power expands significantly, the cost of natural uranium ore will increase to the point that reprocessing is economically justified. However, there is no indication that this point will be reached for at least the next 50 years.

In the meantime, a decision by the United States to return to a policy of reprocessing commercial spent fuel, abandoned in the Ford and Carter administrations, sends a message to other countries, especially in the Middle East and Asia, that reprocessing is acceptable and has advantages compared to the once-through-fuel cycle. And these countries will not use fancy “proliferation-resistant” fuel cycles invented by DOE labs, but rather the widely known and simple PUREX method used by most states that have separated plutonium for a weapon.

The United States, for the foreseeable future, should limit fuel cycle R&D to laboratory research on new separation methods, engineering analysis comparing different fuel cycles, and perhaps some process development unit (PDU) scale engineering studies.

7. *Improve the coordination of energy policy.* The new administration should establish a new inter-agency Energy Coordinating Council, co-chaired by the Secretary of Energy and Director of the National Economic Council to inter-agency harmonization of energy policy including such matters as

I conclude by underscoring the strong linkage between energy policy and national security. James R. Schlesinger and I co-chaired a study for the Council on Foreign Relations that describes how dependence on imported oil and gas is increasingly constraining the ability of the United States and its allies to accomplish important foreign policy objectives. Iran is a good example – its 3 million barrels per day of oil exports is important to international oil markets.

Iran's ability to stop these exports and thus disrupt the international oil market, is a factor that the United States and its allies must consider as they weigh possible actions to slow Iran's effort to acquire nuclear weapons, or to interdict Iranian support to Iraqi insurgents.

This linkage between energy and security exists in other areas as well. For example, how China meets its growing energy demand will increasingly impact world energy markets and hence influence the global climate, as well as how much U.S. consumers will pay for motor gasoline.

The point is that United States must consider the domestic consequences of foreign policy energy decisions and vice versa; the country has not done this well in the past. The interagency Energy Coordinating Council proposed above could be useful in providing the president with a coordinated view of the domestic and international aspects of contemplated energy policy. In addition, the Secretary of Energy should be a participant in any National Security Council meetings that involve energy issues.

There is also strong relationship between U.S. nuclear non-proliferation policy, nuclear force structure, and nuclear power development. The DOE is involved in all three aspects and should remain so in the future because of the breadth of its technical capability. You will hear proposals to transfer responsibility for management of the U.S. nuclear weapons program and the weapons complex from the DOE to the Department of Defense or a newly created independent agency. My experience as Undersecretary of Energy and Chairman of the DOD's Nuclear Weapons Council leads me to believe that this transfer has no bearing on nuclear force policy issues and the transfer would neither improve the management of the weapons program, or save money. Separation of the national laboratories involved in nuclear weapons – Livermore, Los Alamos, and Sandia – would greatly reduce DOE's capacity to carryout its energy mission.

The enterprise of generating, distributing, and using energy in the United States is enormous, complicated, and inter-connected. Casual attention will not constructively shape energy development, or fairly balance the many competing regional and private interests. Moreover, there are no quick fixes or technical break throughs that can sidestep the lengthy and demanding process of adapting the economy and the life style of our citizens to a sustainable, post-petroleum world. The United States has the resources, the technology and talented people, and the industrial base necessary to provide for a secure energy future. However, the country has not yet reached consensus or adopted a national energy policy scaffold that encourages the needed changes in production and consumption, but also has the flexibility to adapt to market reality and accommodate unexpected ingenuity that will emerge from working on this great challenge. It is high time for the country to embark on the exciting and important tasks that I have outlined.