NATIONAL ACADEMY OF SCIENCES

COMMITTEE ON A NEW GOVERNMENT-UNIVERSITY PARTNERSHIP FOR SCIENCE AND SECURITY

NORTHEAST REGIONAL MEETING

May 15, 2006

Massachusetts Institute of Technology
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NOTE: This is an unedited verbatim transcript of the workshop on a New Government-University Partnership for Science and Security held at the Massachusetts Institute of Technology on May 15-16, 2006. It was prepared by CASET Associates and is not an official report of The National Academies. Opinions and statements included in the transcript are solely those of the individual persons or participants at the workshop, and are not necessarily adopted or endorsed or verified as accurate by The National Academies.

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P R O C E E D I N G S (8:35 a.m.)

Agenda Item: Introductions and Purpose of Meeting

DR. GAST: Good morning. I'd like to get started. My name is Alice Gast. I am the Vice President for Research at MIT, and I am the co-chair of the National Academies committee that is hosting this event.

I am very pleased to welcome you, and thank you for traveling from so near and so far. I apologize for the weather. It was here before you came, and it will still be here after you leave. I think the floods don't have anything to do with the topics we are discussing today.

I would also like to introduce my co-chair, Jack Gansler. We would both like to welcome everyone to what we expect will be a very interesting and fruitful meeting. I would also like to thank my office staff and the Academy staff for their tremendous help in hosting this meeting. We are very delighted by the range of expertise represented by the speakers and the audience, and the range of institutions represented over these two days.

We are here today under the auspices of the National Research Council committee called the Committee

for a New Government-University Partnership for Science and Security. We have been charged by our sponsors, the NSF and NIH, as well as by OSTP to identify and host a broad open discussion of the key issues at the heart of the balance between science and security, and to offer them a range of policy options for their consideration.

In carrying out this charge, we are hosting three regional meetings on university campuses. The meeting today at MIT is the first. Additional meetings will be held in June at Georgia Tech and in September at Stanford University. We will culminate this activity with a convocation in Washington in early 2004.

These regional meetings are a central part of the committee's activities to collect input for its report. Therefore, we would like to encourage comments and discussions from the speakers, the attendees, and my fellow committee members. It is important to understand that the committee has not yet drawn conclusions, and we greatly value the opportunity to hear from our participants.

As our speakers frame some of the challenges we face in science and security, we welcome your thoughts and potential solutions. We are particularly interested in

input from the members of the national security and university communities about topics such as controls on discrimination and publications, restrictions on participation in research and management of biological agents.

I would like to remind you that both days we will be in open session, and both MIT and the National Academies welcome both the public and the press to these open meetings. An unedited transcript of the meeting will be posted to the Academy's website in a few weeks.

I also have a word from our National Academies sponsors. This is to state that committees made by individuals including members of the committees should not be interpreted as positions of the committee or of the National Research Council. Committee members sometimes ask probing questions in these information gathering sessions, and such questions may not be indicative of their personal or the Academy views.

The committee will deliberate thoroughly before writing its draft report. Once the draft is written it will go through a rigorous review process by experts unknown to the committee, and then the committee will then

respond to this review, and it will go through the Academy's report review committee and the chair of the National Research Council.

Before getting started with our first session, we would like to introduce each of the committee's members to you. Jack Gansler already raised his hand as the co-chair. Artie Bienenstock from Stanford, LouAnn Burnett from Vanderbilt, Karen Cook, also from Stanford, Gary Hart from Colorado, Michael Imperiale from Michigan, Richard Meserve from the Carnegie Institute, Julie Norris, formerly of MIT and consultant, and two of our members, Elizabeth Parker and General John Gordon, were unable to join us today.

Now it is with tremendous pleasure that I am able to welcome MIT's President, Susan Hockfield, to welcome you to MIT and to help us set the stage for the meeting's activities.

Agenda Item: Welcome and Opening Remarks

DR. HOCKFIELD: Thank you, Alice. Good morning. It is a pleasure to welcome you to MIT. I join Alice in expressing our pleasure in hosting the National

Partnership for Science and Security.

It is clear to all of us that a healthy alliance between research universities, industry and government lies at the heart of the American innovation system and of our innovation economy. This alliance forms the critical foundational infrastructure of our national defense. The questions that this committee addresses could not be more important for our nation's future.

Of the issues that the National Academies identified as critical to the government-university partnership in the wake of September 11, two strike me as particularly important. First, in an increasingly global and interdependent world, what is the appropriate conceptual framework for national security? In other words, how do we organize science and engineering research in a way that takes globalization and global competition into account, while protecting America from people who would use that research for pernicious purposes?

Second, can we afford a national security policy that does not address our economic security? This question can be answered more quickly then the first, so let's start by answering it. The answer is, of course not.

America's national security is inextricably entwined with its economic security. They always have been, and I think we can have confidence that they always will be.

The nation's defense has been the impetus for innovations that have powered our country's economy for a very long time, at least back to 1798. That year, Eli Whitney, who was deeply in debt, had the bright idea of solving financial problems by converting his process for manufacturing cotton gins to the mass production of muskets, which at the time were being made by hand. Whitney received a massive contract from the War Department to produce 10,000 guns over the course of two years.

Now, unfortunately, the reality of precision machine tools hadn't quite caught up with Whitney's ideas for industrial production, so he went on to pioneer two other less attractive aspects of our defense procurement system, massive cost overruns and delivery delays. But Whitney's basic idea was a crucial one. It was in fact the great American contribution to the Industrial Revolution, interchangeable machine-made parts and the division of labor that they made possible.

Others quickly adopted Whitney's ideas for the

mass production of guns, and they did so successfully. Up and down the New England waterways, factories soon employed the industrial techniques that the War Department had sponsored to make simple machines for civilian use. Suddenly America emerged as a great industrial power.

In fact, that story has been repeated again and again throughout U.S. economic history. We can credit Defense Department investments for the evolution of the aircraft industry, the nuclear power industry, the computer industry, the Internet and the commercial satellite and space industry.

DoD underwrote the research and development and provided the initial market that gave birth to each of these critical segments of our economy. During World War II, the Defense Department added the critical third player to the great innovation alliance between industry and government, the American research university, which had been built on an inspired model that married education and research. Investments from federal sources including the Defense Department turned American universities into powerhouses that have become the envy of the world for their contributions to our educational achievement, our

economic growth and our geopolitical strength.

Defense investments were certainly transformative here at MIT, beginning with the Radiation Lab, established here during World War II to develop microwave radar. The Rad Lab designed over 100 radar systems that played a decisive role in the Allied victory. It also established a successful model for connected science, a collaboration between scientists, industry and government that continues today at MIT. At the same time, the work of the Rad Lab formed the foundation for much of the subsequent U.S. electronics industry.

The Cold War then reaffirmed this model for innovation. In 1949, MIT took on the challenge to develop air defense for the continental United States. In the famous whirlwind and sage projects, researchers at MIT's Lincoln Laboratory took the radar technology developed during World War II and connected it to the early real-time whirlwind computer that was developed at MIT. They invented magnetic core memory that made computers more than mere calculators, and they networked the whole complex system of radar and computers, transmitting data across telephone lines.

Operators sat at cathode ray screens. We have got fabulous photographs of these. They used keyboards to work with real-time data, and they used a device against these screens for highlighting data on the screen. That probably sounds familiar to all of you. MIT's J.C.R. Lickleiter saw these elements in operation and clearly drew inspiration from them for his theories of personal computing and the Internet. And of course, we all know the end result, our fantastically vital Information Age economy.

Economist Dale Jorgensen has documented hour information technology powered the U.S. economy to growth and productivity rates that at the end of the last decade approached a remarkable four percent annual growth. In fact, the connection between defense investments and research and development in U.S. economic growth has been so profound that economist Vernon Ruttan entitled his newest book, Is War Necessary for Economic Growth.

With slight rephrasing, this really becomes a chicken and egg question: Is innovation a function of the investments we make in national security, or is national security a function of the investments we make in

innovation? The answer to both of course is yes.

Perhaps the most profound lesson of World War II was that technological advances like radar not only could win wars and spawn industries, they could also transform geopolitics. Certainly Los Alamos, which was founded on the Rad Lab model, taught us that. Science and technology made America a superpower. Let's not forget also that information technology allowed the United States to overcome its nuclear stalemate with Russia at the end of the 1970s. Defense Department leaders Harold Brown and Bill Perry developed an offset strategy, using IT advances to improve conventional weaponry. That strategy and the precision weaponry it produced made the U.S. clearly superior to any power in conventional warfare.

Now, however, we face a new and ever more dangerous world, a world of non-state actors fighting unconventional wars of terror on a global scale, of new peers emerging in China and India and of new security risks resulting from what President Bush calls our addiction to oil. America needs a new offset strategy, innovative technologies that will allow us to cope with current geopolitical realities from a position of strength.

Yet, at the very same moment we face a rapidly changing security landscape. DoD's investments in fundamental research, the territory where transformative breakthroughs occur, has stagnated. DARPA support of university-based information technology research seems to be in freefall, down nearly 50 percent between 2000 and 2004.

In a report spearheaded by MIT's mathematician and computer scientist Tom Leyton, the President's Information Technology Advisory Council warned late last year that the U.S. commercial and military infrastructure is dangerously vulnerable to cybersecurity threats. The Council argued that we need a new technology plan to remedy that. But the Council's report was ignored, and not long afterwards, the President's Information Technology Advisory Council was phased out.

All of this means a steep reduction in mind share, as DARPA used to call it, available for our most pressing national security problems. I worry that we simply do not have the right range for depth of talent, focusing on some of the most crucial questions that face us as a nation.

So as this committee addresses the problems that globalization presents, I hope you will also keep in mind that dis-investments in our research system present an extraordinarily pressing national security issue.

Now I will return to the first question I drew from the National Academy's charge to this committee, how do we reconcile the demands of national security with the now borderless worlds of commerce and information? In the great tripartite innovation alliance between government, university and industry, two of these three partners are increasingly embedded in a global economy. Business and the Academy are essentially on an around the world tour together. American business is clearly globalizing. According to the U.S. Business and Industry Council, in seven years between 1997 and 2004, more than 100 of the 112 major industries studied lost a significant part of their U.S. market share to imports from abroad. Seven of the 112 industries lost more than 70 percent, including machine tools and computer storage. Another 14 industries lost between 50 and 70 percent, including autos and heavy duty trucks, and only four of the 112 industries gained market share against imports.

The global competition is certainly stiff, but some American companies are thriving in it. It is important to remember that our trade deficit with China is largely with ourselves. Over 75 percent of our trade with China is with multinational corporations. As Professor -- from MIT -- Suzanne Berger has reported, U.S. firms are increasingly able to pursue a global contract manufacturing model that may actually increase America's technological lead.

Perhaps the best example is Apple. The ubiquitous iPod was brought to market in less than a year, because it was designed around component parts that were already being made by a number of companies abroad.

At the same time, our research universities are also becoming more international. Students on temporary visas are 32 percent, about a third, of all science and engineering doctorates awarded in the United States in 2003, and the figures are even higher in some fields. Fifty-five percent or over half of all doctorates in engineering and 43 percent of all doctorates in mathematics and computer sciences were awarded to students on temporary visas.

Science is as close as we will ever get to a universal language. Today's institutions like MIT are living proof of that. Of course, our ability to attract intellectual talent from abroad has been one of America's greatest competitive advantages. We must remember that with only infrequent interruption, the United States has long provided a haven for new immigrant and first generation talent. Fortunately, over half of that talent still stays here and contributes to our economic, intellectual and cultural capital in the long term. American universities absolutely depend on this influx of the world's best and brightest. Disrupting this flow of talent will damage our research capabilities, which are vital to both our economic strength and our national security.

The fact is, we are not going to get the genie of the globalized U.S. economy back into the national bottle again, and we are not going to get the international reach of university science, our economy's innovation ally, back into the national bottle, either.

In the wake of September 11, our national security allies have understandably asked whether the

globalization of science poses a security risk. This is a critically important question and an entirely valid one. But the ensuring wave of regulatory efforts in visas and deemed exports address the very real threats in ways that damaged our innovation enterprise. We are concerned, not just because some of the regulatory controls have been disruptive, but also because they have a low probability of actually strengthening national security.

Some interpretations of American exports law currently provoke serious worry, in the assertion that allowing our foreign students and researchers to use certain university equipment is tantamount to sending sensitive technologies overseas.

I think these issues can be addressed successfully. The personal interventions of Secretaries of State Colin Powell and Condoleezza Rice and of Jack Marburger at STP helped to resolve visa problems that until this year have reduced the flow of foreign talent into our universities by more than 25 percent. I believe we are now making very good progress with the Departments of Commerce and Defense on deemed exports, under the leadership of Under Secretary of Commerce David McCormick.

Secretary Rice has indicated her own concern that deemed export regulations not unduly inhibit research on our campuses. But for our part, those of us in universities and industry cannot lose sight of the fact that our allies in government face extremely complex challenges of their own. National security clearly cannot be casually globalized in the same way that we can globalize the manufacturing of digital music players.

Because these differences between globalization in defense on the one hand and globalization in industry and the university on the other, our tri-part alliance is now strained by deep cultural differences. Universities and businesses need the free flow of technological ideas. The federal government needs to keep bombs out of the hands of terrorists. Ultimately, industry seeks return on investment, the university seeks advancement in knowledge. Government seeks to keep America powerful and its citizens safe. All of these goals are critically important, but all of them are also quite different. The structure, organization and modes of discourse of our respective institutions are naturally different as well, so we are bound to mystify each other on occasion.

Even so, our interests are profoundly linked, and none of us can afford to lose sight of that. Technological innovation is so essential to all of our missions that our cultural differences simply have to be overcome.

At MIT, we are fortunate to have wonderful role models who have shown us how this can be done. Deeply committed teachers, scholars and public servants, such as Professor Ernie Moniz, former Under Secretary of the U.S. Department of Energy, Professor Shiela Widnall, former Secretary of the Air Force, Professor John Deutsch, formerly Director of Central Intelligence, and Professor Dan Hastings, formerly Chief Scientist of the Air Force. Likewise, we are very proud that Alice Gast is helping to lead this important committee, and we thank her for the prodigious work that she has put into organizing this conference.

I am expecting that all of you have heard of MIT's great loss and Alice's huge achievement in being named the next president of LeHigh University, and we congratulate Alice on that marvelous ascension.

We also consider it a great privilege to host

this Northeast regional meeting. These two days mark an important step in building some new bridges and repairing some older ones. If any group is up to the job, it is the people who are here today.

As Winston Churchill once observed, the only worse than having allies is not having them. To our great advantage, we have allies in each other. My own belief is that we will find a way to work together and to manage our innovation system so that it both benefits and protects all Americans for many years to come.

I want to thank you in advance for the important work you have undertaken and again, welcome all of you to MIT.

Thank you.

Agenda Item: The Future of National Security and the Research Enterprise

DR. BIENENSTOCK: There are a few people who bring broader and deeper experience to the issues that we face in the future of national security and the research enterprise than Jack Marburger, the Director of the White House Office of Science and Technology Policy.

You have his biography in your folder, so I

won't read from that. I'll just mention a few things. First of all, I cannot avoid mentioning the pride that my Department of Applied Physics at Stanford takes in his having gotten his Ph.D there. He has served as a faculty member and a dean at the University of Southern California, as president of Stonybrook, and then in a deeply difficult role as director of Brookhaven National Laboratory when environmental problems could have sunk that laboratory. I watched him with admiration from Washington in that role. I watched him since with admiration as he has dealt quietly behind the scenes but effectively with our visa situation and the deemed export problems.

So it is a joy for me to introduce him. Jack.

DR. MARBURGER: Thanks, Artie. Those jobs were a pleasure for me for the most part, because I did have confidence that we were working for something very important. The significance of the research university to our national security and national health was I think admirably summarized by President Hockfield.

The committee has asked me to speak this morning to the importance of issues to our research enterprise. The issues in question, I'm pretty sure, are

those that are outlined in the accompanying statement that I think everyone has for this meeting. But I am going to summarize these, because they form the framework for my remarks this morning.

There were six issues that were singled out for attention by the committee. The first, what is our conceptual framework for national security policy with respect to terrorism embargoed countries like China; what are the primary security threats we face and how do government policies serve to mitigate them, and are they effective. The second one is, how do we do international interactions in trade and commerce in the context of the global environment and national security. Third is, how do we balance relative risks and benefits when viewed from the different perspectives of the research and the security communities. I am just sketching. The fourth is, can we develop new paradigms for universities and government to work together to insure scientific progress will also -- now, this is kind of a curious sentence: Insure scientific progress while also insuring cognizance of the potential impact on security, which is not entirely clear to me, but I don't think it completely captures the fact that we would

like to insure that there is no impact on security, but I will talk more about that. Should we continue the past practice of distinguishing universities from the industrial sector, a very interesting question. Finally, how can we insure continuing effective dialogue among government, academia and industry on these issues.

These are obviously complex issues, but I think there is a danger of making them too complex, in the interests of attempting to satisfy essentially incompatible requirements. In my view, practices that are ideal for the conduct of science, ideal for global competitiveness of industry, ideal for the protection of national and homeland security, are incompatible, and compromises in all sectors are unavoidable to optimize our overall performance as a nation, a concept that itself requires some clarification. In other words, what is it that we are trying to optimize in the performance of our nation.

Many of my colleagues act as if there were ways of resolving tensions among the three sectors, perhaps four sectors, if we distinguish homeland and national security, between which there is some tension as well, and act as if there were ways of resolving tensions that would satisfy

all four of these sectors.

I don't share this optimistic view. Therefore, I believe that the last of the six issues, namely, how to insure ongoing engagement, may be the most important, because these tensions are not going to go away ever. The best we can hope for is acceptance among all parties of a minimax solution, a condition that game theorists tell us is the best that can be hoped for in such cases.

By the way, I have never found it reassuring that the optimal strategy in a no-win game sometimes requires players to choose randomly among statistical distribution of responses. I hope that we can do better.

But this conclusion is not as gloomy as it sounds, because perfection in the conduct of science or of economic competitiveness or security is very difficult to achieve in any case, and there is much room for improvement in our society, even given the likely need for compromises. I have confidence that the U.S. can maintain world leadership in all sectors, but probably not in the way any of the sectors would prefer to do it if left to themselves. Our task is to optimize the whole in an appropriate balance which requires understanding of what is truly essential to

the performance of each, and avoidance of practices that optimizes one sector to the severe detriment of another.

Such understanding of what is essential and what is destructive to another sector is very difficult to achieve in the highly polarized advocacy atmosphere that is characteristic of our political process. I am grateful to the National Academies for attempting it through this and, I might add, through many other efforts in the past. This is not the only committee whose work there is on the subject.

So let me address briefly each of these six issues. First, the conceptual framework. I take it as a given that there are active terrorists and terrorist groups now working in the United States whose objective is the mass destruction of life and property and the disruption of our economic system.

As a New Yorker, I can't fail to be impressed by the persistence of terrorist efforts to destroy the World Trade Center, marked by two major attacks separated by eight years, the second of which was successful. I remind that you that the perpetrator of the anthrax incidents of October 2001 is still at large, and that

terrorist activity persists in many other countries, who are quite conscious of it.

I also take it as given that other countries seek to gain economic advantage of the United States' interests not only through trade arrangements, embargoes, price supports, tax policies and subsidization of industries, but also through theft of what is broadly known as intellectual property, whose value to our own economy is increasing rapidly as we shift from raw materials and manufacturing to service as the primary value of our production.

In many countries that we would identify as our economic competitors, the public and private sectors are not as distinctly separated as in the United States, and consequently it is reasonable to assume that foreign states as well as business entities and individuals are engaged in the game of economic one-upmanship.

While we are not currently at war with any foreign state, potential adversaries are not difficult to imagine. I think it is safe to assume that at least some other governments are attempting to reduce by espionage the current enormous military advantage the United States

enjoys over all others.

I am recounting these perhaps obvious facts for two reasons. The first is because in a discussion of the impacts on science, where most of the people in attendance are academics and concerned about these issues, but also concerned about their institutions and their own work, we might be tempted to give the reasons for such impacts too little significance. Second, because in our era, the means by which terrorism, economic vandalism and the subversion of military effectiveness may be accomplished have grown ever more powerful. While these evils have been around for a long time, their threats are magnified today by ubiquitous technology and a rise in capabilities of adversaries associated with the phenomenon of globalization. More people can acquire more means to cause destruction.

So back to the conceptual framework. The conceptual framework in which policies are formulated to mitigate such threats is not well defined, but the existence of the threat is real. It would be convenient for policy formation if we could have a model, something like a computer simulation like Sim City or some of these

other simulations that give us practice in managing cities or power plants or other things, a model to trace causes and effects for all the possible bad things that could happen. Then we could take logical and systematic steps to prioritize these impacts and the probabilities, call it probabilistic risk assessment, and formulate procedures and preventive measures to deal with them in a logical way.

In some domains of what we might call the threat space, policy makers do attempt to do this. I think the work of this committee gives some of these efforts more visibility.

Policies designed to prevent industrial espionage or the proliferation of nuclear weapons do exist and do have negative consequences for the conduct of research. I might add that any restriction on the free flow of people or ideas has negative consequences for science.

I can't speak to the effectiveness of these measures, and I am talking about export controls and nonproliferation regulations, and I think it will be difficult to find metrics for them that can be used to compare with their negative impacts on science.

I think the impacts on science, despite numerous well documented instances, are likely to be equally difficult to quantify in terms necessary to perform a cost-benefit analysis. These policies were not arrived at through risk assessments or cost-benefit analyses, but through the accumulation of expert opinions filtered through the democratic processes of our form of government. No matter how clear and crisp a policy recommendation may be, or how cogent the proposals that the President makes every year to Congress turn out to be in the annual budget process, Congress inevitably holds the purse strings and makes the ultimate determinations of what the frameworks will be under which regulations are formulated. Through Congress we have an enormous variety of forces exerting their impacts on the outcome.

So, so much for framework. I'm not trying to get answers here. I am suggesting that we have a difficult task ahead of us, and one that will be enduring.

On the second issue, I can't contribute too much to the second issue, about how we view international interactions, trade, commerce, et cetera. International interactions, trade and commerce have always been linked to

national security. This is the stuff of history, including the story of the birth of our own nation. The balance between controls and openness is determined by political forces within each nation.

I have to say that science is small potatoes when it comes to national policies on trade, commerce and security. There was a time in history when science had a huge impact on national security, during the World War II, but it was a sharp and focused impact, and the debates in Congress and the magnitudes of efforts associated with issues tends to place science in the minds of most legislators off in a corner relative to price supports and international trade agreements.

At one time, we could argue that the conduct of scientific research was such small potatoes that it might as well be excluded from policy making in these areas. Indeed, policies governing classification for both national and economic security do include various exemptions or fundamental research, designed in various ways and in various places.

The essential question for research here is just how significant a player is university-based research

in this enormous game of international hardball. It has become somewhat more significant roughly since the enactment of the Bayh-Dole Act in 1980, giving universities ownership of intellectual property developed with federal funding. I will return to this question in connection with some other issues.

Unfortunately, we have tried so hard to convince policy makers of the value of university research to economic security that persuading them that our products do not need more quote protection unquote may be awkward. We have sold ourselves maybe to our own disadvantage, to some extent.

While these are provocative ideas, let me move on to the third issue. We certainly cannot balance relative risks and benefits viewed from different perspectives of the university and security community in the absence of some kind of quantification of risks and benefits. Quantification would be very difficult, except possibly in those cases when the risks and/or benefits are zero. If one or the other is zero, if the impact of some of our work that is regulated has zero impact on security or economic security, then policies should acknowledge it

and regulate accordingly.

I'm not sure what comprises the security community, but I am guessing the community of policy makers is larger. If the risk of some aspect of university-based research that is currently regulated is zero, then relevant policy stakeholders need to be educated about it, as implied by the statement of this issue in the materials.

I believe that occurs, that educational process, on an ongoing basis, for example, in the interaction between the academic publishing community and the Department of Commerce in connection with providing services to countries that harbor terrorism, an issue that is still being worked out, but the Department of Commerce as in some other cases is making an effort, and is listening.

In general however, the regulations respond to laws, and laws are made in a much wider context that makes education or negotiation challenging. Of course, that is the purpose of committees such as this, to bring together sectors that include a sufficient number of people representing the whole process.

The fourth issue seems to be a generalization

of the case of possible inadvertent fostering of bioterrorism through university-based research. The means for producing sophisticated bio pathogens are inexpensive and accessible to individual and small groups with even moderate training.

There is a good record of university-government cooperation on this issue. Indeed, paradigms have been invented for grappling with it. I refer you to the NRC report called Biological Research in an Age of Terrorism which came out in 2004, the so-called Fink Committee report, an excellent report that was listened to and taken seriously by government, my office and others. The Department of Health and Human Services responded to this report by creating a process and a panel, the National Science Advisory Board for Biosecurity, and the panel is meeting and it is grappling with this issue.

In many cases, the solutions or resolutions to these problems are not final solutions, say do this and everything will be okay. There are processes which insure an ongoing mutual consciousness raising negotiating on specific cases.

I have watched this process from the beginning,

and I believe it is an excellent case study for the kind of interaction between government and universities that can be useful. It is not perfect, but it is like an existence proof for a paradigm of continual engagement.

The fifth issue about separating the universities and industrial sector implicitly acknowledges the changing character of universities with respect to engagement in the broader economy. Universities have always formed nucleation sites for economic development, and university research products have always fed into commercial applications as well as security applications. Faculty have consulted with industry, students have worked with part time employees in industrial settings for many years.

From the national and economic security point of view however, things have changed over the past few decades. I have already mentioned the Bayh-Dole Act as a milestone in the history of university intellectual property development.

Although recent data shows a dip in the industrially sponsored university research, the historical trend is generally up, which means some university

laboratories and offices contain proprietary material, intellectual property, of value to the sponsor and therefore presumably to the sponsor's competitors. Because of their generally weak security management systems, universities are very attractive targets for industrial espionage.

Universities are also attractive targets for other forms of mischief. Their powerful computers and servers are ideal for recruitment and denial of service attacks on other computers connected to the Internet. Universities are in fact very significant targets for cyber vandalism. Their cyber security and document protection regimes are often weak, exposing data on their employees, students and business relationships with other entities.

The Internet alone has changed the significance of universities in the overall national security picture. I take it as a given that industrial and foreign government espionage targeting universities has increased significantly during the past decade. Universities are too valuable to their communities to sever the links that make them vulnerable, so they have no choice but to be treated in some respects like industrial entities.

Beyond espionage, universities offer a variety of opportunities for terrorism. Shortly after the attacks of September 11, 2001, I prepared a short list of vulnerabilities that I used in discussions with presentations to university presidents and various organizations that represent universities. Under security issues, I gave the following list that I would just like to read quickly.

First is the presence on campuses of individuals with terrorist inclinations. Second, the access to hazardous materials of possible use in terrorist activities. Third, the access to sensitive facilities that could be exploited in terrorist actions. Access to sensitive information. Exploitation of university environment to conceal terrorist activities. Exploitation of vulnerable populations on campuses for recruitment or agitation.

These are things that universities today have to be conscious of. The universities are very important places for issues of terrorism, vandalism, cyber security, national security and economic security to come together. It is one of the reasons why it is so important for us to

be engaged.

Six finally, because of the difficulty of quantifying costs and benefits of security measures and the impact of university research activities affected by those measures, I see an enduring need for an engagement of the sort advocated by this committee. I do not think this committee or any committee or standing group by itself can be effective in the long run, that is to say, finally effective. We have to have continual engagement.

Opportunities for engagement with our regulatory agencies are built into our legal code, and they should be exploited. Direct approaches to the agencies, to Congress and to policy coordination offices such as my own, OSTP, will always be possible, and it is reasonable for the National Academies to have a standing committee to address these issues. It is reasonable to expect the Office of Science and Technology Policy will always play a role in them.

Ongoing engagement among the at-risk sectors is essential to respond to the continually changing and poorly defined threats that we perceive. All parties need to learn more about the others, and even about themselves.

Research faculty for example are rarely well informed about the challenges their own campus administrators face daily in their efforts to balance their budgets and fulfill their statutory obligations. We should not act as if the industrial or national security communities are homogeneous or of one mind on the issues that we are here to discuss. There are deep divisions among them, many individual opinions, and sometimes the one that counts most is the one that has the most significant personal contacts.

I have stressed the challenges and the difficulties and the impediments to resolving the problems that led to the creation of this committee. Perhaps the most difficult challenge of all is communicating to others the deep conviction we have as academics and scientists that the unimpeded flow of people and information is the very foundation of human progress. The instinct to hunker down and cling to ways that worked in the past is powerful in human affairs. It is even more insidious because sometimes it seems to work in the short run. But in the long run, societies that put up barriers to external influence lose ground with respect to the larger world, and eventually either wither to a marginal status or are forced

to change course abruptly and under external pressure in ways that are not in the intermediate run good for their populations.

Our nation currently enjoys a huge global advantage that is to a great extent the result of its freedom at every level in society. Nowhere is the importance of that freedom greater than in the conduct of scientific research. I fervently hope that the work of this committee can provide a firm basis for this conviction, and transmit it to those remote from the research enterprise on whose collective opinions our freedom depends.

So thanks to the committee for giving me an opportunity to say some of these things, and I look forward to hearing more of the discussion.

DR. BIENENSTOCK: I'm sure Jack will take some questions. Let me ask those of you who have questions to step out to the microphones and tell us your names and affiliation. Questions, comments?

DR. KELLMAN: My name is Barry Kellman, DePaul University College of Law. The question is to the committee as a whole. It is more about what I haven't

heard than what I have heard this morning. What I haven't heard I find troubling, because it characterizes the question in certain ways. I want to focus on two points.

One, I am hearing a lot about how global commerce generally, the global movement of ideas and materials has an impact, potentially negative, on national security. I am hearing no discussion about international security. I am hearing no discussion that relates the commerce in science and ideas to for example the millennium development goals. I am hearing no discussion about how we integrate discussions of national security with wider issues of international security.

The second point goes with the first. I am hearing no discussion about the rule of law. I am hearing no discussion about the development of institutions or the lack of the development of institutions and how this failure at the international level precludes our ability to aggressively push certain agendas in the international community.

I understand the way the question has been phrased. I understand the mission given to the committee, but it seems to me that the way the question has been

phrased, excluding those considerations, I think excluding those considerations, pushes the answers in a direction even before you start.

Thank you.

DR. MARBURGER: Of course, you have to realize that you have only heard the introductory address from President Hockfield and my rather philosophical broad overview. Maybe you will hear more about those things.

There is a vast set of interconnected issues here. One of the problems that the committee has to grapple with is how to winnow down to a set of issue upon which it can make reasonable recommendations.

I might say that we have lots of big ideas available to us, ideas that started being expressed after World War I, about the importance of international organizations in limiting the spread of war and discord among peoples. We have lots of ideas about frameworks and idealistic views about how people should operate.

Some of the most serious questions that the university community and the research community are grappling with now are not associated with big ideas, they are associated with the implementation of smaller ideas

about how to proceed in specific instances. We probably can make some progress on those.

I think there are appropriate forums for both kinds of discussion, but my sense is that -- and I am not part of the committee, I won't speak for the committee, I will let them speak for themselves, but we have some acute issues right now that we have to deal with, where some regulations that are occurring in the context of the existing poorly defined framework are really chafing on certain operations within universities and research laboratories, and we are trying to make this shoe fit better.

So I would urge patience, and I would also urge a pragmatic point of view in these discussions, how do we really address some of these issues -- export controls, nonproliferation regulations. As I said in my remarks, we don't really know how well some of these regulations are working, and the committee really needs to work hard to smoke out methods for assessing that. We don't really know whether the operations of the universities are having a big impact on some of these issues, proliferation issues, for example.

So I would urge patience and pragmatism.

DR. BIENENSTOCK: I think Jack has expressed well the reasons for constraining the charge or defining the charge carefully.

At our first meeting, these broader issues did emerge and were discussed, and I suspect they will continue to be discussed as we do seek as well to focus on the specific issues where we think we can have impact.

DR. PEARSON: Alan Pearson from the Center for Arms Control and Nonproliferation in Washington. I want to go back to the first point you were addressing, which was the framework for thinking about national security and the role of universities within that.

In talking about that, you made the point that you took it as a given that there were terrorists in the United States that sought to cause massive damage to the country. You drew the example of the anthrax attacks of 2001 as an illustration of that.

I'm not sure that is a great example however for this committee to be thinking about when they are thinking about the framework, because as you point out, those attacks are unsolved. There is quite a lot of

uncertainty about who perpetrated the attacks, where they came from and what their motive was.

Without understanding any of that, it seems to me to be a relatively poor example on which to build a framework, especially for thinking about the role of bio science and national security, which is obviously one of the key issues the committee would be addressing. So I wonder if you might address that a little more.

DR. MARBURGER: Let me tell you why I include that. First of all, the attacks occurred and they caused enormous disruption to the nation. They shut down the Supreme Court, both Houses of Congress. Washington came to a stop, there was panic across the country. These are the kinds of things that we would like to try to avoid.

I would include that incident in the entire spectrum of issues that national security policies have to address. We have just as much to fear from disruption from our own citizens, who are bent on causing havoc, people who are vulnerable to recruitment by forces of chaos around the world, whose inclinations towards violence might be enhanced by practices that we inadvertently encourage. I think that it is quite relevant to know that we have people

within our society who are in the United States, who are exploiting opportunities for creating havoc and disruption at the highest levels of government. That is part of it.

We don't know where the terrorist attacks come from. Terrorism operates opportunistically in many ways. They recruit people who may be U.S. citizens, government employees, anybody. The reason that I include this incident is because precisely it served to expand our conception of the threat space. The threat space is very broad, and it is folly to stereotype a terrorist action.

That is why it is so difficult to characterize. Some of the most disruptive terrorist actions that we have had in the U.S. have been by our own citizens disgruntled by the way government works. Their reasons might be different from the reasons that an Al Qaeda member might attack us, but the result is the same. To some extent, protective strategies that we might adopt are very similar.

In another version of this talk, I said a lot about the role of the social and behavioral sciences in this whole picture. We have powerful tools today of understanding the motivations of people and identifying intent that we are not using for one reason or another,

partly because some of these techniques require changing attitudes about freedoms. We are seeing a debate in the papers today about the collection of phone numbers, for example, which are presumably part of an effort to identify forces within our society that could lead to terrorist attacks from anywhere.

So we have got to think very broadly about the issue of terrorism. If you focus too narrowly, you miss it.

MR. HART: Dr. Marburger, if terrorism as a threat disappeared tomorrow, would America still be secure? That is to say, by focusing the issue almost totally on terrorism, aren't we missing the broader point of America's role, indeed the international role, of the 21st century, and a redefinition and broadening not just of the meaning of terrorism, but the meaning of security.

DR. MARBURGER: You are exactly right. I did try to spread the threat space a little bit beyond -- considerably beyond terrorism. Certainly economic security is a very important part of this, and that is even more poorly defined, because you can't isolate the impacts of economic vandalism, you might say. It is hard for me to

find a single word to describe what it is we are concerned about, but security related to the economy. It is much harder to identify specific incidents or events in the way that you can identify terrorist events.

There is an overlap here in the means that we used to collect information, to recruit vulnerable people, to take advantage of information technology, for example. Some of the same technical infrastructure of our society that makes us vulnerable to terrorism also makes it difficult for industries to protect proprietary information or to maintain competitiveness with respect to a business plan, or the increasingly abstract value added that we have in our service economy.

I think this is a very serious problem of definition, what is it that we mean by economic security, whose security are we talking about. President Hockfield made a very important point when she pointed out that the fraction of the Chinese research numbers that are reported is direct investment by U.S. companies. So these are difficult issues to disentangle. But there is some overlap here. There is some overlap.

DR. MASERVE: I'm Dick Maserve, I'm a member of

the committee. Jack, I was struck in your remarks and your discussion of universities that you talked about the many dangers that they might present as a haven for terrorists, that there might be terrorists present that have access to materials at universities, sensitive information, sensitive facilities, capacity from universities to proceed with attacks and then hide.

I must concede that there is at least that theoretical possibility, but I am not aware myself, and I don't have access to many actual examples of that situation being exploited. In order to set a context for the committee, I think it would be helpful if you could say something from the perspective of the inside policy maker in Washington about how significant you really feel universities are as a haven for terrorists.

DR. MARBURGER: I personally believe that universities are a major target for industrial espionage and terrorist activities, not overt activities that might draw attention to themselves, but for recruitment, for access to facilities that make it possible for the terrorist activity to continue.

Universities are the most open institutions in

our society, as they must be. Therefore they are very convenient for these types of activities. I'm not sharing any secrets or anything that one can't read about, but we know that university information systems are very vulnerable. There are thousands of cyber attacks of various kinds I would say even per day. Talk to any director of any major computer facility about these things. It might be useful in to get someone to talk with you about them. The universities are quite vulnerable to these things.

Now, I am making these remarks on the basis of my experience as the director of Brookhaven National Laboratory and the president of a research university for many years. Admittedly my term as president ended in 1994, but even then I was aware of things happening on our campus that disturbed me a great deal, and that I felt responsible for, but didn't know quite how to respond to.

The universities have links to all of these targets that we would probably be more likely to admit are attractive to terrorists, industrial espionage, access to government records and so forth.

So I believe that it should be possible for the

committee to find out more about some of these things. I personally think this is a serious problem. Universities are perceived to be vulnerable by many policy makers in Congress and Congressional staff and government. That perception itself is something that has to be contended with in making recommendations about how to proceed.

DR. IMPERIALE: Mike Imperiale, University of Michigan and member of the committee. You gave an example of how the academic community and policy makers might be talking of how the journal publishers got together with the Department of Commerce. That is more of a reactionary type of issue. I am wondering how your office acts on a more proactive basis to foster those types of interaction.

Certainly trying to put together panels like this and have the Academy inform the government about what is going on is one thing, but that is a long drawn-out process. I am wondering on more of a day to day basis how do you engage the academic community when you need information. Do you rely on other governmental agencies, or do you try to find people in academia who might be able to inform the government as to what is going on out there in the world?

DR. MARBURGER: Our primary source of information are the organizations that have the activities. So we work with the professional societies, American Chemical Society, for example, American Institute of Physics, places that publish journals, IEEE, about their concerns about these -- specifically talking now about restrictions on providing services, public editing services to Iran, let's say, which is one of the things that led to legal discussions between the Commerce Department and the publishing industry.

We don't rely on government sources. We rely primarily on the people who have the issues. With respect to universities, we work very closely with the AAU, the American Association of Land Grant Universities and Colleges, COGR, American Association of Medical Colleges and so forth. So we work with all of the above.

Your questions had a lot of aspects to it.

DR. IMPERIALE: It sounds like even working through those organizations it would take some time for things to trickle down and trickle back up. I know that with COGR sometimes, those questions will get trickled down to me; I am chair of our institutional biosafety committee.

But if you need information right away, let's say there is some deemed threat, you could go to the intelligence community and get their input, but do you have a way to solicit the expertise in the academic community on a real time basis?

DR. MARBURGER: Sure, I personally know a lot of people in universities and in the community. We have about 40, 50 people in our office and we have a pretty big network, and we are in touch with a very large community virtually all the time. I give two or three talks a week in different parts of the country and talk with people, and I sort of know what is happening

Typically, the potentially troublesome policies are coming from laws that are on the books. These laws are subject to a continual interpretation and reinterpretation by the regulatory agencies. Typically what will happen is, a regulatory agency will be criticized by its inspector general or by a committee or some sort of examination or audit that is commissioned by Congress or by the agency itself. The audit will come up with a finding that says, you guys aren't being tough enough, so why don't you do something. So the regulatory agency will publish a

proposal or will float a proposal somehow to see what the impact might be, and there is suddenly a huge reaction from people.

We try to understand those things that process from the beginning. We try to be aware of adverse inspector general reports like that, so that we get the early warning signals from the agencies themselves. We try to work with agencies on the wording of their announcements to the community, and on the process by which they subsequently refine the early ideas.

Commerce Department, State Department, Department of Justice, Department of Homeland Security are all partners in this process, and we interact directly with them to advise them on what a likely course of action will be, given that they feel they have to do something. We say why don't you try it this way, or work out this process involving mechanisms that the university community is comfortable with. Then we are an advocate or a broker during the subsequent steps of that process.

So we have, you would probably say surprisingly good information in real time about what is going on out there. But mind you, the driving force for a lot of this

stuff are laws that have been on the books for many, many years. It is the continual interpretation of those laws in the current context as provided by the normal auditing and oversight mechanisms within government itself that causes some of these frictions.

I would point out that after 9/11 there were no changes in immigration policies or laws regarding visa awards to students. It is just that more visa applications were forwarded back to Washington for review in Washington than at the consular offices. There was no basic change in the process for reviewing. There was just a greater concern on the part of consular officials that they might inadvertently let a terrorist in. They didn't want to take that responsibility, so they sent the applications back to Washington, creating a huge backlog. There were some changes, by the way, but they didn't affect a very large fraction of the volume that was generated.

So I think we have good information, and we are working all the time as these issues emerge.

DR. BIENENSTOCK: Mike, let me say, my experience was the same as the associate director of OSTP. When there was an issue of which we became aware, the staff

would be on the phone with links to the universities immediately. There were many, many links with associates that they would call beyond AAU and COGR and the organizations that provided so much help in those circumstances.

DR. SKOLNIKOFF: Professor Eugene Skolnikoff at MIT. You just gave at least two-thirds of the answer to the question I was going to ask. It has to do with what seems to me an inevitable bureaucratic response to this kind of threat, but also to a climate of fear. It may have decreased a bit since 9/11 but it certainly is around. You pointed out the problems with the Congressional committees and holding people up from agencies saying why aren't you doing more, be tougher and so on.

I think it goes beyond that than simply what the Congress is likely to do, but the whole climate inside the bureaucracy. I think some of the directions both with visas and with export controls, they are better now than they were. But part of that was simply taking the bureaucracy, taking the signals from the top, seeing a climate of fear, worrying about their own fears, their own future.

It may not be a fair question, but what sense do you have as to how do you deal with this kind of an issue, which is as I say somewhat inevitable, nevertheless you can't ignore the fact that bureaucracy has responded in risk averse ways.

DR. MARBURGER: Before I answer that, let me point out that the response of a bureaucracy is rarely to signals from the top. In these cases, the people that are responsible for making the decision, we call them bureaucrats, and we think of it is a somewhat disparaging term, but these are people who seriously feel the responsibility. They actually do make decisions that affect us, our institutions and our work.

They are reading the newspapers and they are watching television, and they are watching C-SPAN and the hearings in Congress. They know who the appropriators are, and they know who the powerful people are in the U.S., or they think they do. They respond to the whole context.

Typically, believe it or not, when you are talking about signals from the top, the signals from the top are almost always more rational and ameliorative than the signals they receive from watching television or

reading the newspapers or the very alarmist kinds of op-eds and things.

Bureaucrats are people who are independent minded and have to form their own judgment based on all the directions they receive. We don't have this rigid hierarchical structure where the President says do this and everybody does that. More often, the President is saying, hold on, guys, don't go overboard here. It is very hard to have signals even from the top that go against the grain of the decision makers at these lower levels, to protect themselves and to be as conservative as possible.

So we have a problem. I do think that leadership from the top is an important part of solving that problem or making things better. It is sometimes difficult to get the top leadership to take some of these issues as seriously as they might early on in the process. It is not until a groundswell has developed that brings the visibility of the issues up to the attention of the top management and they step in.

A good example is the conference earlier this year that President Hockfield referred to, where Secretary Rice and the President himself participated in addressing a

meeting of university presidents, in which their commitment to openness in these issues and so forth was expressed. Those kinds of things are important, but they rarely are available at the beginning, at the time when the early decisions are made that caused the concern.

So in an atmosphere of fear that we have, probably it is more fear of the unknown. People aren't sure what the cause is of these bad things that they read about in the newspapers, and just want to make sure they don't happen to us, in an atmosphere like that, the tools for addressing it are increasing visibility of the rational approach and interpretations.

It is one of the reasons why the National Academies are so important, because they have credibility. When a report gets press coverage, it helps to tone down the response of the press to these issues.

DR. GANSLER: I'm Jack Gansler, co-chair of the committee. I guess I should first add to the original question, are we going to consider the international environment that was addressed to the committee. The answer is, clearly you have to. Something like pathogen control is something that has to have international

agreements rather than just a domestic one. We have to get to that question.

My question relates more to almost a followup to Jean's last question. When Susan spoke, she said a lot of these actions now being taken aren't necessarily having a real effect on national security, whether it be in terrorism or rogue states or possible future peer competitors. You said and she said also that we have to balance these against economic concerns and the growth of the economy due to these activities on campus.

What I am having difficulty in understanding is where in the government, what organization. You might say that a spasm response might be Commerce, except the initial cause of all of the deemed export was coming from the Commerce IG that everybody overreacted to. You might say that Defense would be considering some of this, but Defense went even further in responding to their IG reports.

Your last statement said you have to get to the President of the United States. I'm not sure that is really the place that you get this balance between what has been an enormous impact from the universities on the economic growth of the nation, and the concerns of these

possible security issues at the university campus. Where in the government level is that addressed, at a policy level, not as you said the bureaucratic level?

DR. MARBURGER: There is no one place, because universities themselves have these multiple facets that address different policy areas within government. So there is a higher education component, there is a research component, there is a national security component, and not all of them come together in my office or even in the Domestic Policy Council in the White House.

In general, when we have an issue, let's take for example the program that the President announced in his State of the Union message, the American competitiveness initiative, which is obviously related in some way to the National Academy report, The Gathering Storm. In order to put together that initiative in the President's budget request, probably four different policy offices in the White House had to come together, but principally Domestic Policy and OSTP, but the Economic Council was involved, Council of Economic Advisors were involved. We had the Labor Department in, we had the Secretary of education, Secretary of Commerce, Secretary of Energy. We brought

them all along with us.

So these issues are not centralized because the universities themselves have such different functions in society. The research university is a very complex organization. From the point of view of the Secretary of Education, she doesn't care too much about whether there is research going on or not. But from the point of view of the National Science Foundation or my office, we care a great deal about it. So this is a fact of life.

And now, the universities because of the increasing presence of proprietary, possibly economically valuable information exists on university campuses, this is not entirely unprecedented, but it is very rapidly increasing. Universities have got their foot into the industrial world and the economies in a very direct way to an unprecedented extent, and that creates yet a new issue. We don't have a fully formed policy apparatus to deal with that in a coherent way.

Maybe there can be some recommendation about this, but it is hard for me to imagine one that would fit very well. I think ultimately we do have to have multiple centers within government to get together to deal with

these things.

The National Academies for a long time has sponsored these government-university-industry roundtables, which potentially could possibly be more useful. It may be that the committee could have a recommendation about how to use that mechanism more effectively.

The problem with the roundtables as I see it is that they tend to be somewhat static, and the same people meet all the time. They may not be the people who need to be engaged in any particular issue, but the concept is a good one. Perhaps there is some way of making it more effective.

DR. BIENENSTOCK: We have time for one more question.

DR. CASAGRANDE: Thank you. Rocco Casagrande, Gryphon Scientific, formerly of MIT. I was wondering if this committee's job is a little complicated by the fact that there is a very large problem that they are trying to address.

Speaking solely on security as defined by keeping our lives inviolate, as opposed to our livelihoods inviolate as you mentioned earlier, there seem to be two

distinct problems that are completely separable in my mind as far as the policy that flows from them.

The first is keeping away from people who mean to do us harm the materials and the research that already exists versus preventing research or at least preventing the access to research that would create something new that doesn't yet exist that could do harm. So a question not of engineering, but of novel research.

So speaking in terms of biological warfare which is my background, are we trying to prevent bad people from getting access to the technology that was worked out in the 1950s, just getting access to the pathogens and the systems that we already know how to make but just applying them, versus, are we trying to prevent researchers from creating a new pathogen that would have novel capability that no one has thought of yet?

So my question is twofold. One, are these two questions really separable? Can this committee address one without addressing the other? And second, if they are separable, which one is of a greater threat?

DR. MARBURGER: Once again, the committee can speak for itself, but my view is that those questions are

not really the right questions. What we are really trying to do is to prevent the incidents. In terrorism we are trying to prevent terrorist events. In the loss of economic competitiveness we are trying to protect against the actual theft of something, actions that go outside the legally accepted standards for doing business internationally. If we keep our eye on that, it is the end result that we are trying to prevent.

There are so many different ways that those incidents -- it is easier for me to think about terrorism than it is to think about the economic aspect of this, which is muddy in my view; that is one of the problems. But in acts of terrorism, there are so many different routes from basic knowledge to a terrorist event that I think it would be a mistake to have a sweeping regulation that tried to restrict research in some area.

That is why the government has very deliberately not done that with respect to bioterrorism. The government has set up a process that relies on university-based committees to advise the government on what it should do in any particular case. We rely on the editors and publishers of the technical journals to take a

look and tell us whether something is being proposed that might be a problem in their view.

To try to define areas of research ahead of time that are dangerous or shouldn't be done, that is a terrible idea. Most people at any rate that I talk to in government think it is a bad idea. But we are getting dangerously close to that in some of the ways that we operate. The technology alert list for example is something whose use one needs to understand, to try to make sure that it is not misused.

I think that is the kind of thing that we need mutual education about. The relation between basic or fundamental research and some undesirable end result is very difficult to define. In bioterrorism, as you know, the means for bioterrorism are quite inexpensive and easily achieved by people with relatively modest educations, so what is it that triggers the ability of a terrorist to create a really awful pathogen? That is a question that the science community itself has to provide some answers to, and how to deal with it.

I mentioned in response to an earlier question the importance of the social and behavioral sciences. One

of the things that we don't talk enough about is the identification of intent and the identification of the people who are likely to perpetrate an undesirable incident, whether it is an economic or terrorist event.

We aren't doing much with that. It is terribly inhibited by our attitudes toward personal freedom and civil liberties, but we are missing a big dimension of the problem if we ignore that. It may be that the only way that we can protect the basic research is to go farther down the chain and try to understand how we can catch people who have these capabilities. Capabilities are out there. We have to catch the people who would use them for evil intent before they actually do their thing. That doesn't have very much to do with university-based research, but it may have something to do with the social environments of universities and other institutions in our country, and it may have to do with some way of detecting behaviors, with signatures of behaviors.

Right now, as a society we are very ambiguous about this, but it may be the only thing.

DR. PEARSON: If I may refine my question a little bit?

DR. BIENENSTOCK: I think we have got to go on. Thanks, Jack, for meeting with us on these vexing issues.

Agenda Item: Government Policy for Homeland Security

DR. IMPERIALE: Our next speaker this morning is Stewart Baker. Mr. Baker is the Assistant Secretary for the Office of Policy Directorate in the Department of Homeland Security. He has been involved in various bodies that have dealt with the interface between security and technology, including aspects such as electronic commerce and digital encryption. This morning he is going to discuss the government policy for homeland security. Secretary Baker.

MR. BAKER: Thanks a lot. I come out of the private sector, the practice of law, and just was confirmed in October of last year. But I hadn't been on the job more than a day before somebody called me a bureaucrat, so I understand the spirit in which some of the questions are being asked here.

What I thought I would try to do is just do an overview of some of the ways in which government and the research and academic community interact on national

security-homeland security issues, and perhaps give you a view of how it looks from the Homeland Security Department side of the table.

There are a couple of issues where I think the question of homeland security interacts with academic interests, and where we tend to take a rather different view of the problem. One of them is obviously immigration. The Gathering Storm report was an excellent job of stating the case for academia. It had a number of suggests that I thought were fairly constructive. It was a thoughtful report and relatively balanced in terms of acknowledging the gains that have been made in streamlining some of our visa processes for students and the like since September 11.

I think we all acknowledge that we need to do a better job of making sure that our visa processes are fairly efficient, swift, do a good job of distinguishing real threats from paper that has to be moved around. I think we have begun to do a better job of analyzing security issues and doing it in a timely way. I think universities have also done a better job of realizing they have to stretch out the time lines to be making requests of

us for visas.

I think there is also a perception on the side of the government that visa policy has become a convenient reason to give for what is a broader international competitive pressure on American universities for students. It is the case that there are a lot of other countries that are happy to offer students the same kind of immersion in English and exposure to strong academics that have traditionally been available in the United States. This is no longer an uncontested market. Universities are going to have to respond to that competition in effective ways, including price.

I am a consumer of university services through my children. I once said when I was writing a check for tuition, I don't think I would shop anywhere other than here if people sent me letters from the store, bragging that 75 percent of the people who shopped there got a better price than I did. But everybody seems to think it is a selling point that I am paying full tuition, but 75 percent of the people are not. We do need to address the question of how to be competitive internationally in order to attract students from abroad.

I also thought -- and this is a question that will become more salient as we talk through the policy for immigration, that is to say, what do we do to attract students, scientists, technologists from outside the United States to come and stay and work and immigrate to the United States. The Gathering Storm report spends a lot of time talking about that, and I think constructively, but there is a fundamental assumption about immigration patterns that reflects our history, but may not reflect our future. We are attracting immigrants who will stay and become committed to the United States over the long haul. That is our history, that is our expectation.

I'm not sure though that we will see that in the future. Who here knows of all the national groups that send people to the United States, who have people living here, which group has the lowest rate of becoming citizens, naturalization rate? Does anybody have a guess? The French? No, it is not the French. No, it is easier than that. The Canadians, and just behind them are the Mexicans, who are probably naturalized at half the rate of other nationalities.

When you think about it, you say of course,

because they can go home on a weekend. For them, this is not necessarily home, this is where they work, and their ties to their home country are constant, deep and easy to maintain. That is true for both of our neighbors. But as airfare gets cheaper communications get better, as you continue to read your hometown newspaper, even if it is in Bangalor when you get to Silicon Valley, it becomes easier to stay half committed to your home country, and it becomes easier to say, as I think most immigrants feel, they want their kids to have a tie to the old country that is deeper than the one they are going to get from attending U.S. high school. So increasingly, people will take their kids home for the summers or for a year of school and the like.

So we are increasingly facing a future in which the view of the United States by people from other countries, especially the high tech folks that we are interested in attracting to the United States, is a lot more conditional than it was for the people in the last great wave of immigration at the turn of the last century. That may have an effect on the kinds of policies that we adopt for immigration purposes, because I think we can no longer assume that people who come here and even acquire

citizenship aren't still thinking that maybe in 15 or 10 or 20 years, as we have seen with Chinese and Korean and other nationalities, that they may take what they have achieved and take it home in order to achieve things at home that are difficult to achieve here in a more developed and more competitive scene.

That does have to have an effect on how thoroughly you commit to the notion that, if we can just attract people here, that our society will end up transforming their values in the ways that we have seen with past waves of immigration.

So that is one set of problems, the immigration problems. I would also like to talk about export controls. The Department of Homeland Security is in charge of enforcing export controls from the point of view of conducting investigations and the like, so we have a stake in that issue as well.

I recognize that there is a peculiarity from the point of view of academics in the notion that just standing up in this classroom and talking about a scientific topic could be viewed as an export to half a dozen or a dozen countries, that is counter to common

sense. The fact is though that the Inspector General reports that we are concerned about here really were reflecting the state of the law as it was understood by most companies for years. What is new is the application of those principles to academic institutions. It is very uncomfortable for academic institutions, but I think not so different from the rules that have applied to business for decades.

I do think that the criticism is fair that this is a little bit of a Cold War paradigm, the notion that we have all the technology and the people we are worried about don't. That is not the case for many of the people that we worry about. That is the case probably for some of the last autarchist regimes that have seceded from the global network that we are comfortable in, countries like North Korea. They don't have technologies that are otherwise common in the West, and there is still some hope of making it difficult for them to acquire them. But autarchies obviously are the long mechanism for developing a strong country. Most of the people that we will have to worry about in the 21st century as rivals to the United States are not going to take that route, and export controls on

the assumption that we have a monopoly on technology are not likely to be useful in addressing that problem.

But I would like to talk a little bit about the question, if you take the view that export controls aren't an ideal solution or even an effective solution for some of the problems of the 21st century in the security mode, what are the mechanisms that we need to deal with these concerning security issues? Here I would just like to touch on one of the security concerns that I have as a personal matter, and that I think people inside the government share to varying degrees.

That has to do with biological terrorism, biological warfare. I am not an expert in biotech or biological warfare. My technical experience to the extent that I have any comes out of the computer world, where I worked with a number of clients over ten or 15 years, and where I was general counsel of the National Security Agency.

But if you look at some of the parallels between what has happened in the computing world over the last ten or 15 years and apply them to biotech, it is a troubling pattern. We have had one biological terrorism

attack in the United States in 2001. There is certainly a plausible theory, though I wouldn't say it is necessarily the case, that that was an attack by someone who wanted to dramatize the risk, who was an insider, who understood what the risks were, thought that the country was insufficiently attentive to them, hoped to send a harmless warning to people, and instead the effort to send the warning and dramatize the risks got out of hand and had significant unintended consequences.

In 1987-88, Robert Morris in the computing world, a true Internet insider and security insider, wanted to dramatize the risks of computer viruses to the Internet and to computing, and constructed a worm that was designed to show that it was pretty easy to exploit security holes in the Internet. That worm got out of hand and brought down the entire Internet, and he ended up being prosecuted for the first computer virus worm incident on the Internet.

That was about 15, 20 years ago. Since then, computing and computing security has gone through a number of phases. Six or seven years after that attack, the Internet was in the first phases of an enormous boom and enthusiasm. People would acknowledge that there were

security issues and they would take some random steps to address the computer security issues, but most of the attention, most of the enthusiasm was devoted to the enormous good that the spread of Internet networked computing could bring, and that cheap computing could bring. There were certainly substantial advantages that were brought by that movement.

Yet today, while we are still enjoying those advantages, the amount of time you have to spend protecting yourself is substantial, the amount of money that you have to spend protecting yourself is substantial. If you simply went unprotected onto the Internet with a Windows machine today, it probably wouldn't take you 20 minutes before your machine was infected, conceivably fatally or at least in the hands of somebody else.

That is a remarkable change in 20 years from the first effort to dramatize security risks to a universal risk of infection. It has a lot to do with Moore's law and the rise of computing capabilities, the ability of people to go from having to write their own code and understand the risks in substantial detail themselves to having point and click tools that allow people to create attacks by

virtue of the work that has been done by many others, making their capabilities available to millions instead of hundreds or thousands.

My concern is that the biotech community is on a very similar curve in terms of capabilities for individuals to the one that we have seen in computing over the last 10 or 15 years. It is driven in part by computing and other similar technological changes. So we are clearly on a curve in which the artificial reconstruction of smallpox viruses is quite conceivable in the near future, in which creating viruses today is not that difficult, even reasonably sophisticated viruses.

What I don't see, and I grant you immediately that export controls is not a solution to that problem, this technology is going to provide enormous good, has enormous opportunities, economic and otherwise. We are, just as we were six or seven years after Morris' worm, in a stage of enormous enthusiasm for the great good that can come from this technology. But my question as we struggle with this is, how do we deal with the risks that will come inevitably with the capabilities that we are putting in the hands of more and more people.

In fact, I guess I would make the argument -- again, I am happy to be corrected by those who are more expert than I -- that the risks are rather more substantial with biology than with computing, because with computing the machine will only do exactly what you tell it to do. When you are dealing with life, it wants to feed and it wants to breed, and if it gets a chance to feed on us and breed in us, it will. So even where people don't intend to do bad things with the technology, the biology has a will of its own and an inclination of its own to turn itself into a self replicating mechanism and to act in spontaneous and unexpected ways, which means that we don't have to even posit people who intend to do us harm in a radical way. They could easily be people like Robert Morris, who just wanted to show what can be done and who lose control of what they have built.

I don't have the answers to that. I will posit that immigration policy, visa policy, export control policy is not the answer. I'm not convinced that we have the answer. I hope that in our discussions for the rest of the time that I am standing here you can suggest some ideas about how we can address these problems more effectively

with tools that are a little better suited than our existing tools for the problem.

So let me stop there and open this up for more of a dialogue.

DR. IMPERIALE: Thank you. We will open it for questions.

PARTICIPANT: I am a little concerned with the notion that immigrants who go back to their home country have not brought back the values of the U.S.

I want to tell you a little anecdote. I just came back from Taiwan. I was working with a small startup company. The president of that company received his Ph.D in Germany. He did his postdoctoral work in the U.S. He went back to Taiwan as the chairman of a department of a university to set up a center based on an American model that he had learned as a postdoc. He followed the same steps many of our other faculty members did. He got tired of being a faculty member. He is a very brilliant man. He set up his own company.

It works with monoclonal antibodies, technology we might say he can't do now if he can't -- we might go that route. That company now has an agreement with a major

U.S. pharmaceutical company, as well as having an agreement with a major U.S. research university. in fact, they are going to go IPO in the United States. They are beginning to move their company to California, an office in California, although research will still be done in Taiwan, so they can go IPO in the U.S. That is a benefit to the U.S. economy.

So I am concerned with the notion that we worry about people going back to India or China and whatever, and we create barriers to the free movement that is going to damage the U.S. economy rather than help us. Small startups are good whether they are coming out of Yale or Stanford, or whether they are coming out of the University of Taiwan.

MR. BAKER: Certainly that is a view. I think there are a lot of people who would say, so the research is going to be done in Taiwan and the marketing will be done in the United States, so we will hire lawyers and finance people in the United States and marketing people in the United States, but the research is going to be done abroad. That is flipping our notion of the value that we get as a country from developing scientific talent in the United

States. I'm not saying that there is no value, but it is a rather different value than the one we ordinarily think of from attracting scientific talent to the United States.

PARTICIPANT: Some of that research is going to be done at Stanford.

MR. BAKER: No, I'm not going to tell you that there is no value to that. There may be some substantial value, and we are increasingly going to become a globalized society in research and technological capabilities. The day when we dominated those fields are gone. Nonetheless, I think at some point you may ask, how much of a sacrifice are we prepared to make in the hopes that there will be spillover opportunities from developing the scientific sectors of other countries. There may be some value in it. That is not the case that I thought The Gathering Storm was making.

MR. HART: Mr. Baker, what has the U.S. government done to help secure Russia's smallpox virus supplies?

MR. BAKER: I'm not familiar with what we have done, and I'm not sure that the Russians are particularly eager to share their security measures or to give us the

kinds of assurances that we would like.

The open literature that I have seen on this suggests that after a brief period of talking fairly candidly about their past biological capabilities, that a veil of substantial secrecy has fallen over those capabilities, which leaves a real question about what they are currently capable of doing, and whether the smallpox virus is stored only in the one place it is supposed to be stored. We don't have great information to independently verify the assurances that the Russian government has given us.

MR. HART: Are we talking to them about it?

MR. BAKER: I'm not. I'm not aware of that. There would be plenty of people at the Defense Department or the State Department who might be doing that, but I'm not read into any of that.

DR. BAKER: Jim Baker, University of Michigan. I also serve on a number of advisory committees, among them for your Department, so I share your concern about bio weapons. I think something Dr. Marburger touched on, the fact that because the technology is transparent and dual use, intent becomes crucial. Intent is best defined with

HUMINT, which is the thing that has deteriorated most since 2001 because of the limitations put on activities across different sectors in our economy.

One thing I would like to ask, serving on advisory committees for DHS, there has been at least early on an intent to segregate DHS activities such as the NVAC from expertise in both universities and in the commercial community, to the point where these activities were so isolated, they basically collapsed. I'm sure you are aware of the problems currently with the NVAC program and the fact that it basically doesn't exist anymore.

What are the plans for DHS to integrate the expertise in IO and other areas into their own efforts to develop the resources that can help them figure these questions out? Because right now it is a stovepipe that nobody has input to.

MR. BAKER: I am very concerned about that. I will frankly say, I think we need to have the academic community meet us halfway on that. There really has to be a sense of real urgency displayed among researchers about addressing these problems, and some creativity about how to address them. I think it is not just about research, but

about what the capabilities are that we are making available technically to a lot of people that we don't know or whose motivations we aren't in a position to address.

I will take as an example your suggestion that the question is intent and the solution is HUMINT. I'm not sure that that is quite the case, if by HUMINT you mean human intelligence, that is to say, spies. If that is the right answer, then I suppose the answer would be that there should be spies in all of the research laboratories around the world that are capable of sophisticated biological weapons development using commercial technology.

DR. BAKER: I think the concept of spy is outdated. I think the community of biologists is best able to identify people who are outside of the mainstream and might be inappropriate to have technology.

MR. BAKER: I completely agree with you on that. That is not what we think of as human. In some senses that is open source intelligence. This is not something that the government is going to solve. It is going to require a genuine community of concern among scientists who have this capability, who will be watching out for behaviors that are troubling.

DR. BAKER: We are already there. You just need to reach out to us.

MR. BAKER: Okay.

DR. GUILLEMIN: Good morning. I am Jeanne Guillemin from the Security Studies Program here at MIT. My area of expertise is the history of biological weapons programs. It is very striking to me that as this committee assembles there seems to be a tendency to group all the sciences together. So I was very pleased to hear your comparative references for example to information technology and biological sciences. I thought that was really apt and very good.

However, what also strikes me is that up until the last few years, we have not had microbiologists, people in the biomedical sciences in universities and government in any particular program where national security would also be an element. In 1969, President Nixon renounces the U.S. biological weapons program and basically creates a sharp division between university biomedical research and national security agendas, and that was it in 1969. But since the anthrax letters and since 9/11, we have a new project which is called bio defense.

So my question to you is, do you in your work consider the risks that the bio defense project generates? This is something that has been discussed by a number of people in the biomedical sciences and outside the biomedical sciences. To wit, if you have let's say 9,000 or 10,000 more scientists who are familiar with select agents and how to produce them, and you also knew how to create -- some subset of that group also knew how to create aerosols of pathogens that are select agents, is that not a cause for concern?

So I am just going to ask you that question. Is this something you ponder in your work?

MR. BAKER: Yes, it is. You do have to worry about that. That is why I started out with the theory, which is just a theory, that maybe the anthrax letters were somebody from the inside trying to dramatize the threat just as Morris was.

That is a significant concern. On the other hand, the idea that if we don't ask how could somebody do this, we will be better off, is a recipe for being totally surprised when somebody does.

This is not as hard as we would like it to be.

It is harder than the New York Times might suggest, but it is disturbingly possible. It requires some level of organization, a level of organization that so far we haven't seem from terrorist organizations, at least after September 11.

On the other hand, one of the other lessons from the IT world is, some of the security attacks were developed by people who said, look here, I have developed a security attack, and I am releasing it to the world so that everybody knows what it is, because I have also developed a tool that will allow people to tell whether they are the subject of an attack of that kind, and I am going to sell the tool. There was an element obviously of extortion to that business model.

That is not an inconceivable business model in the biotech world, either. So you have to begin to ask, what are the potential commercial motivations here for the introduction of pathogens into the world.

So I think we shouldn't be focused just on the risks of terrorism. We have to ask what institutions might be capable to doing this and why might they do it.

DR. GUILLEMIN: Thank you.

DR. GANSLER: I was just struck by your comment about the fact that -- in your opinion, you said that export controls and visas and things like that are not the mechanism for the solution to the problem. One of the things that we are asked to specifically address is the sensitive but unclassified, which coming from your Department of Homeland Security, we are seeing increasingly being discussed. I would be interested in your position relative to that.

MR. BAKER: I do think that there is a really unfortunate divide that you can trace back to the '60s between government and academia with respect to a whole host of topics, but it includes the question of what is appropriate information to share and how should it be shared.

It is deeply worrying to have everything published. I think that there has been a relatively constructive development inside academia, recognizing that there are some things that it is probably better not to publish, and that is really welcome. In may cases it is not classified information. To the extent that the concept of sensitive but unclassified information that ought to be

restricted because of the risks and the growing sense among researchers that there are certain things that it would be better not to publish, to the extent that we can bring those together, as opposed to having a debate that is driven by, if the government tells me to keep it quiet then I have an obligation to publish it, to the extent that we can get beyond that debate and get to a more consensual use of concepts like that, I think that there is some value to that. It is not a complete solution either, but it is worth trying to find a way in which there is agreement on what is sensitive but unclassified information that ought not to be disseminated everywhere.

DR. MESERVE: I am Dick Meserve from the committee. I would like to follow up on your observation you made about the fact that many immigrants coming to the United States today may have more conditional alliances to the United States than in the past, as a result of communications, ease of travel, Internet and so forth.

I think you can make two opposing arguments as to what the implications for immigration policy could be, and I would be interested in your views. On the one hand, one might argue that people who return home, who have these

connections into the United States, so to build a web of interactions in the globalized world that ultimately are very desirable and beneficial to us. On the other hand, there may be some who argue that they return to their home country with capabilities that they might not otherwise have, and that ultimately is a negative for us.

You have raised an issue as to the implications for immigration policy, but haven't taken us to the next step as to how you think we should think about this problem. I would be interested in your views.

MR. BAKER: And I appreciate that. I'm not sure I have a final conclusion on that. It is something that I am still struggling with.

We have started with the assumption that once people come here and become citizens, that's it, they are going to stay, they have cast their lot permanently with the United States, and they are a permanent addition to our polity. Increasingly though, it is clear -- the first wave was Korean scientists, especially IT scientists, going back because they could get more opportunity. There were fewer people with their skills in Lucky Gold Star than there were at IBM, and so they wanted to go back and work for Lucky

Gold Star, and it was a going home.

That was a surprise, even though that happened in the '90s, and for the first time we realized the planes fly both ways. That does mean that you can't just assume somebody is here, they are a citizen, and they are committed to us. They may go home, and they may go home to a country that is increasingly not aligned with the United States.

I think there is also an interesting phenomenon in the IT world where companies, and you see it with Yahoo and Google in China today, that wouldn't in a million years cooperate with the United States government in an effort to engage in searches of data without a warrant in order to find somebody who was a dissenter, would do it for the Chinese government, on the theory that they knew their government and they weren't going to let their government do stuff like that. But the Chinese government, that is somebody else's government, and it is multicultural to let them to what they want.

Increasingly, there are people who feel that way about the U.S. government everywhere in the world. I think some of the reaction to the Iraq War was a sense on

the part of people in every country that in an odd way, they ought to have a say in U.S. government policy because they have had a stake in the U.S. by virtue of being educated here or worked for a U.S. company, or been exposed to U.S. media. So those protests were a sense on the part of people that they ought to have a vote, and they didn't vote with us.

So we have got a whole bunch of people who are engaged with U.S. policy as though they were nationals, but they are in other countries. There is good and there is bad to that. I recognize what one of the earlier questioners said, sometimes we want people in other countries to be deeply engaged with us in that sense, but for all the people for whom that works out well, there is always one or two -- I think the founder of the Muslim Brotherhood had an exchange in Colorado of all places. In 1948 he came out to Colorado, Grand Junction, I think, spent a long time there and was exposed to a church social where men and women danced together, holding each other. He came back to Egypt determined that the United States was the Great Satan and had to be dealt with. Many of the strains of Islamic radicalism that treat the U.S. as the

enemy can be tracked back to that summer in Grand Junction.

So you never know how it is going to turn out to have people engage with the U.S. We just shouldn't kid ourselves that it is always going to be sunshine and light and people rediscovering democracy and free speech.

DR. SMITH: I'm Toby Smith with the Association of American Universities. I have a question about the Department's commitment to generating the knowledge base of the next generation of young scholars who are going to address these tough issues that we are talking about.

On the heels of 9/11, the presidents of our association passed a resolution urging that perhaps we needed to think about how to encourage students into these areas, and perhaps a fellowship program was in order. In response to that, the Department did create a student and scholars program aimed at attracting young people from different disciplines into areas to specifically be applied to homeland security.

This year, what we are hearing is that there won't be enough funding for the next round of students and scholars. So I guess that is an immediate concern, given that we do know these threats exist. To delay training

people or getting young people interested is a concern of ours, but I am interested more broadly too in terms of what the Department is thinking in terms of generating the base that you need at the DHS to do your job effectively.

MR. BAKER: This is a concern. We have been the beneficiaries of the great enthusiasm of young people for this field. I am constantly impressed by the talent that DHS has been able to attract, the work ethic and the quality of the workforce is quite remarkable in my experience. It is because people made a commitment in the last four or five years, were able to study in the field, come already familiar with a lot of the issues. So I would be a big supporter of trying to find a way to continue that.

To some degree it is a question of making sure that people want to be in the field as opposed to throwing money at it. But we do have to make sure that we are supporting the people that will provide the next generation of leaders in that field.

DR. IMPERIALE: If there are no other questions, I would like to thank Secretary Baker. I'm sure the committee will find your perspectives very useful.

MR. BAKER: Thank you.

DR. IMPERIALE: We are going to take a break and reconvene at 11 o'clock.

(Brief recess.)

Agenda Item: Energy, Security and the Long War of the 21st Century

DR. MESERVE: I have been asked to request that those of you who have Blackberries, to ask that you turn them off so that you are not receiving messages. Apparently the interference we have had with the P.A. system is as a result of the Blackberries that are on in the room. I am among the guilty, I apologize.

We are now going to move to the subject of the intersection of energy and national security. This obviously is a subject that is very much in the news as the result of the increases in gas prices. The issues with regard to petroleum are very much on peoples' minds. Sixty to 65 percent of our pooled reserves of petroleum are in the Middle East. That is obviously an area of instability, where there are totalitarian regimes, some of whom are antagonistic to us or our culture.

So in the case of petroleum, we have a perfect

storm of national security narrowly confined, economics and environment all intersecting with each other, and presenting challenges for us in the 21st century.

Also issues in the news about Iran, and the possibility that in the apparent pursuit of civilian nuclear power that countries will develop fuel cycle facilities that will involve either the enrichment of uranium or reprocessing, which obviously presents a proliferation threat.

So we have some very important issues that relate to this intersection of energy and national security. We have a superb speaker to be able to deal with those issues for us. He is R. James Woolsey, known to most of us as Jim Woolsey. He is currently a vice president for Booz Allen Hamilton, and before that was the Director of Central Intelligence. He has had a number of important government positions before his role as Director of Central Intelligence, and I know he is also someone who has been involved in a variety of energy related studies in recent years. So he is somebody who is very knowledgeable about the subject. Jim.

MR. WOOLSEY: Thanks, Dick. I was of course

quite honored to be asked to be with you today, but since like Dick I spent some 20-plus years as a Washington lawyer and then some time at the CIA until I went straight and went with Booz Allen four years ago, I am actually honored to be invited into any polite company for any purposes whatsoever.

I wanted to share a few thoughts with you this morning about this intersection of energy and security. I am going to talk pretty much exclusively about oil, not because it is the only issue, but because I think it is a very central one, and certainly in the questions we can branch off into nuclear energy, Russia's heavy had with the natural gas and so forth.

Most of us, either with hairstyles like mine or gray hair, spent most of our lives in international security area developments, focusing on the Cold War. It seems difficult for me to believe that it has now effectively been over for 17 years, since the Berlin Wall went down. Our current assumptions about how to deal with a long struggle against a difficult enemy I think are often implicitly at least derived from our Cold War experience.

The Cold War was a long period of containment

and deterrence, the two centerpieces of our strategy, against a large, rather rigid, rather bureaucratic empire, whose ideology was effectively dead at least by the mid-50s, by the time Khrushchev gave his '56 speech before the Party Congress, displaying all of Stalin's crimes.

The Soviets did a lot of things in a somewhat repetitive way. They developed radar the same way. They put scars on the ground in Siberia in the same way, so you could tell right away whether it was going to be an SS-18 or an SS-19, from the way they were building the fences. They were quite predictable in a lot of ways. They weren't all that predictable about the way they came apart. Almost nobody got that right except three or four people at RAND and two major public figures, Daniel Patrick Moynihan and Ronald Reagan, each of whom said about a decade before the fall of the Berlin Wall that the Soviets will only last about another decade. I guess what I think about that is, sometimes the Irish just hear voices that the rest of us don't hear.

But nonetheless, a lot of what they did was relatively predictable, and we did not normally in a day to day basis live with the Soviets in a state of concern about

their coming after us here in North America. Yes, of course, there was the nuclear standoff. We now know, mostly because of Castro's craziness, that we may have come relatively close to nuclear war in 1962, but on the whole, we lived our lives the way one would normally live one's life. We weren't worried about Soviet guerrillas attacking infrastructure and all the rest.

The world that we live in now in this long war -- I like that phrase better than global war on terrorism because it is war against much more than a tactic; long war is probably about as good a terminology as any -- this war is not only different from the Cold War with respect to several of its important features to some degree. It is completely different from the Cold War in almost every way that is important.

This war is not against a single large bureaucratic empire. It is -- I'm going to set aside North Korea here for a moment, North Korea is crazy enough to be part of the Middle East, but it doesn't happen to be, and I am going to essentially focus on the Middle East -- this war is against several, at least three, major totalitarian theocratic movements in the Middle East. There is not one

empire, there is not one state. There are issues with respect to several states and several movements. There are for example velayat-e-faqih, the rule of the clerics in Iran, today taken over by a revolution within a revolution, Ahmedinajad and his primary mentor, Ayatollah Yazdi in Qom, the circles around them who are highly committed to the notion not only that the Shi'ite Messiah, the Mahdi, should return, but rather that he should return soon and that should be accompanied by mass deaths, hopefully from their point of view leading to the end of the world. This is not a program most of us would sign on to.

Over on the Sunni side of Islam, there are at least two major movements. One, jihadis such as Al Qaeda and affiliated supporting organizations, the Muslim Brotherhood and others, that are focused one eventually establishing a worldwide caliphate, beginning with the Arab world and the Muslim world and the world that used to be under Islam but is no longer such as Spain, eventually the world as a whole, and unifying mosque and state in a theocracy under a caliph. This is why bin Laden says that 1924 was the worst year in the history of Islam, because of the Ottoman caliph having been disestablished by Attaturk.

That movement teaches fanatically hatred, genocidal hatred, of Shi'ites, Jews, homosexuals and terrible repression of everyone else, including particularly women, absolute hostility to democracy, and all the rest.

It is mirrored in another grouping, the state religion of Saudi Arabia, the Wahabis, whose views together match those of Al Qaeda's on pretty much all underlying material points -- the same hatreds, the same oppression, look to parallels between the Taliban, Afghanistan and Saudi Arabia today. The only thing they disagree on is who should be in charge, whether or not one should feel free to go flying airplanes into buildings whenever one wants, or whether one should put one's ideology at the service of the House of Saud. This is loosely, only loosely, but loosely paralleled with the relationship between the Trotskyites and the Stalinists in the 1920s and 1930s. Both were revolutionary Marxists who believed in the dictatorship of the proletariat; it was just a question of how you got there.

With these interacting, sometimes hating, sometimes killing, sometimes interacting and supporting one

another, movements in the Middle East, together with the fact that the 21 Arab states, unless one -- and I think it is a bit optimistic at this point -- counts Iraq, there are no democracies in the 21 Arab states of the Middle East plus Iran, and that 22 states translates into -- their languages particularly into Arabic, fewer books every year, about as fifth as many as are translated into Greek; keeps over half of its women illiterate, and exports other than oil and gas to the world less than Finland.

So we are dealing with a very closed set of societies in the Middle East. One key point, they will be in tumult for a good deal of the future, I think for decades, not necessarily all-out war, but heavily in something approaching chaos, in parts of it in any case, and exporting values heavily at odds with those of the Western democracies for a long time.

The fact that this part of the world holds two-thirds of the world's proven reserves of oil creates a very special problem for us. We are locked into petroleum as the fuel for our transportation sector. It is used of course heavily in some other sectors such as heating and industrial chemicals as well, but about two-thirds of the

some 22 million barrels a day or so that we use are for transportation.

By being so locked in, we have essentially no substitutability possible if something happens with respect to oil. What might happen is of course heavily related to the nature of the Middle East. One thing we would need to concern ourselves about would be terrorist attacks such as the attack that was launched against Obkake late in February. Saudi guards effectively fought off a clumsy attempt, but Obkake is interesting because it is the site among other things of the sulfur clearing towers that if taken out according to most experts who have looked at it, let's say with a hijacked aircraft being flown into them, would take six or seven million barrels a day offline for well over a year, and certainly send oil up well above $100 a barrel, quite possibly headed north toward $200.

It is not only terrorist attacks in the Middle East. It is also the possibility of a change of regime, and this does not need to be violent. King Abdullah is probably about as accommodating to the non-oil exporting countries as a Saudi king is going to get. He is well into his 80s, however. If his successor is for example Prince

Nayef, the interior minister and all-out Wahabi, we would have rather serious difficulties dealing with Saudi Arabia. It is said that whoever governs there in the Middle East generally needs to sell their oil. They don't need to sell nearly as much of it if they are perfectly happy, as bin Laden says he would be with a $200 a barrel price, if they want to live in something approximating the seventh century.

One can also of course even look to current government policy such as Iran's threat to withdraw a million or two barrels a day for a time, send prices skyrocketing, if we continue to press them on their nuclear fuel enrichment and therefore their nuclear weapons program.

These aren't the only problems that are geared to our dependence on oil, and hence over the long run our heavy dependence on the Middle East. We borrow about $250 billion a year just to import oil, nearly a third of our overall trade deficit last year. That is a billion dollars every working day. Some fair share of that goes to a number of oil exporters. A chunk goes to Saudi Arabia.

Saudi Arabia makes about $150, $160 billion a year

exporting oil. As recently as the early '70s they made two billion dollars a year, but it is remarkable what these high prices will do., They give something on the order of four billion a year to the Wahabis to foster their spread of their religion. The medrassahs in Pakistan and elsewhere, some literature we found in Freedom House here in the United States comes from this four billion plus per year. That is incidentally about four times what the Soviet Union was spending on so-called active measures through the KGB through the peak of their power in the late 1970s.

As that money gets spent, children in the West Bank, in Pakistan and elsewhere learn by age eight that their objective should be to be suicide bombers, that Jews and Christians should not even be spoken to, much less dealt with, and so on.

So part of our problem in this long war is that this is the only war other than the Civil War that the United States has ever fought in which we pay for both sides. This is not a sound long term or even short term strategy.

The $250 billion makes a major contribution to

our needing to pay interest rates sufficient to get the rest of the world to hold dollars, exporting a billion dollars worth of IOUs every working day just to put downward pressure on the dollar and upward pressure on interest rates, as we are beginning to see now. That however is a minor problem for us, compared with what happens in a country like Bangladesh, when they need to import $70 a barrel oil and pay for it with hard-earned dollars, fall more and more heavily into debt, as does much of the developing world, at least that portion of it that doesn't export oil. The possibility of their paying for that with what they can export by way of textiles and foodstuffs, or what they can get through any kind of reasonable foreign aid program, is negligible.

So we not only have that difficulty. We also have something that is highlighted very well in Tom Friedman's recent piece in Foreign Policy magazine, in which he asserts, and I think with good reason, that the price of oil and the pace of freedom head in different directions. One need only look at the behavior of Russia, Venezuela and Iran over the course of the last couple of years to give substantial buttressing to Friedman's thesis.

Other academics, Mr. Collier at Oxford and others, have made this same point; where there is a lot of academic rent to be had, then that tends to concentrate power in the hands of a central state. It doesn't tend to interfere with an existing democracy's operations. Norway and Canada export oil, but are likely to stay democracies. But states that are on the border or are autocratic certainly don't develop the institutions of dispersed economic power that can lead to things like growth in civil institutions. They don't need for example a legislature, because legislatures, one of their major functions is to tax people. The Saudis don't need a legislature because they don't need taxes.

So there are a set of reasons why oil is a special problem and not just a market commodity, and not just a problem, although it is certainly one of the environment. I should of course have mentioned that transportation is second only behind electricity generation in its production of global warming gas emissions. This is yet another bad thing for Bangladesh, because a couple or three feet rise over the rest of the century in oceans from glaciers melting basically sinks Bangladesh and a number of other low-lying parts of the world beneath the waves.

So we have a special set of problems about oil that are beyond its commercial status. We need to pay some attention to how to deal with that.

First of all, paying attention to oil on the whole is a separable issue from paying attention to electricity generation. In this country anyway, only a little over two percent of our electricity comes from oil generating facilities. So you can be a fan of nuclear power or wind farms, it doesn't matter, you can put one of each on every hillside and you wouldn't do much with respect to influencing our oil use. There is a footnote to this having to do with plug-in hybrids that I will get to in just a moment.

If we are going to focus on oil and transportation, we have got to focus on oil. Some of its other uses is heating oil and industrial chemicals, but transportation first and foremost.

What is a bad idea? A bad idea is continuing to do what we are doing, driving our SUVs, consuming a great deal of oil for transportation purposes, continuing to deepen our ditch that we have dug ourselves, and to dream only of a faraway day in which we will have a

hydrogen economy and the hydrogen highway will lead us there.

I'm sure there are important uses for stationary fuel cells. The idea of putting our eggs into the basket of someday having restructured a large share of the energy infrastructure to get say natural gas in every filling station, reformers in every filling station, hydrogen stored at every filling station and restructure the entire automotive business so that fuel cells will be affordable and will be in every vehicle, and who goes first, Alphonse or Gaston, through this gate, the energy companies or the automobile companies. To dream of that world as the answer, as has been basically public policy not only of the federal government but of the state of California and a number of other institutions for several years now, to my mind is a very bad idea, and has almost nothing to do with being able to move promptly with the types of issues and concerns I just stated. We found on the National Energy Policy Commission that there would be no substantial effect on oil use by moving toward hydrogen fuel cells for automotive purposes for the next 20 years.

Instead, we should focus on changes which will

reduce substantially the use of oil, and do so within the existing infrastructure, or if not within the existing infrastructure, in that infrastructure with modest changes.

What might those be? I'll touch on these and leave the rest of the time for questions. I'm not going to speak about the instrumentalities here, loan guarantees, tax credits. We can deal with those in questions and answers, if one wants. But it does seem to me some of the technologies that meet those criteria are the following.

First of all, plug-in hybrids. Hybrid electric-gasoline vehicles themselves if done right might save 30, 40 percent of your gasoline, just as a good modern diesel would. What is interesting to me is not particularly hybrids for their own sake, but rather a plug-in capability, increasing the capability of the battery by let's say something on the order of a factor of six, going from one and a half kilowatt hours up to about nine kilowatt hours. With current nickel metal hydride batteries, that adds maybe 150 pounds, but large scale developments of plug-in hybrids probably are principally going to await moving toward lithium ion, some variety of

lithium ion or other batteries for that increase in capability.

What is interesting is that if one has a nine kilowatt hour battery instead of a one and a half kilowatt hour, plugging in overnight gets you probably on off-peak power, which goes for the equivalent of well under a dollar a gallon of gasoline in propulsion terms, not the energy that is stored so much, but where the rubber meets the road, one can talk about driving 20, 25 miles a day on all-electric, the overnight charge, and then moving into the hybrid mode of going back and forth between electricity and gasoline.

Since about half the cars in the country drive less than 25 miles a day, that means for a large number of vehicles you would be going to the filling station very, very rarely, but you always would have the insurance policy if you needed to take a long trip of having fuel in the tank, unlike the case with all-electric vehicles.

Second, ethanol from cellulose. Many in this audience know a great deal more about this subject than I, but let me just touch on one aspect. We looked at the numbers very carefully in the National Energy Policy

Commission's report published about a year and a half ago now, and we found that by utilizing the genetically modified biocatalysts in yeast, it makes it possible to move to exploiting cellulosic biomass such as switchgrass, prairie grass or agricultural waste.

One could, if one had under cultivation say the 39 million acres that are already in the Soil Bank in the conservation reserve program, and are planted, most of them, in something like switchgrass in order to replenish the soil, with those 39 million acres, making reasonable assumptions about improvements in yield over the course of the next ten to 20 years, and improvement in mileage of vehicles, we could replace by 2025 approximately half of the country's gasoline with ethanol from cellulose. Those numbers differ by a factor of two to four from the numbers that were in John Deutsch's op-end in the Wall Street Journal a few days ago. We can get into that if you want. It has to do with assumptions about land use and the like.

The third is diesel from all sorts of renewable sources, not only bio diesel from soy and Willie Nelson's restaurant grease and so forth, but rather all sorts of ugly material that one needs to get rid of, like

slaughterhouse waste and chicken litter being dumped in the Chesapeake and hog manure and used tires.

There are now thermal processes written up in the April issue of Discover magazine very effectively, that make it possible to utilize feedstocks of that sort that are not only cheap and widely available as is the case with switchgrass for ethanol, but rather better than cheap, namely, tipping fees, getting paid to take them away. Europe has much bigger tipping fees than the United States, but one of the Con Agra executives told me, the process they are using at Carthage, Missouri if taken to Europe, since Europeans pay $100 a ton to take dead animal carcasses away, that since they would be using feedstock to produce diesel of negative $100 a ton instead of a feedstock that costs them $400 to $500 a ton, namely, oil, that they could if they did it just right give the diesel away free and still make money.

The fourth technology that is of particular interest is the one that Amery Levins and the Rocky Mountain Institute have advocated for some years now, namely, copying the Formula One race cars and moving to the use of carbon composites. Cheaper than those in aircraft,

maybe 20 percent of the cost, but 80 percent of the crash resistance, which is itself about ten times that of steel. The substantially lower weight improves fuel efficiency, and essentially divorces size and weight from safety. The reason a Formula One racer when it crashes and rolls still has the driver walk out of the car with airbags and harnesses, but doesn't damage the car particularly is because it is made out of carbon composites.

Those four technologies together create the possibility of making very substantial changes relatively quickly in our oil use. Look at the infrastructure impacts compared with say hydrogen. The infrastructure impacts of a hybrid plug-in are A, you need bigger batteries, and you have got to figure out how to dispose of them and deal with them and B, every family would need an extension cord.

With respect to cellulosic ethanol, one needs flexible fuel vehicles. This is not rocket science. A different kind of plastic in the fuel line costs a little over $100 a car when newly produced. Brazil went in two years from five percent of new vehicles being flexible fuel vehicles to 75 percent of the new vehicles being flexible fuel vehicles. So if Detroit cannot figure out how to do

that, they can send a delegation to Sao Paulo and sit at the feet of the Brazilian engineers.

With respect to diesel from waste products, effectively the facility is relatively small and inexpensive, attached to bigger facilities that do things like create chicken litter. But infrastructure change, none in particular. The Carthage plant of Con Agra and its little partner, CWT, produces number four diesel very cleanly. You can either refine it further down to number two and a gasoline, or you can ship it off to an oil company's refinery and let them do it. Carbon composites, yes, would require some definite changes in the way Detroit makes vehicles.

But on the whole, one could at least conceivably here be talking about taking a 50 mile a gallon Prias, making it out of carbon composites, so let's say it is now a 100 mile per gallon Prias, making it a plug-in hybrid, which would make it something on the order of a 200 to 250 mile an hour per gallon Prias. Then if you run it on E85, 85 percent ethanol, you are up in the ball park of 1,000 mile per gallon of petroleum Prias.

Suppose this portfolio that I have described is

not the right one, and two or three of these I am being too optimistic about. Fine, let's say only a quarter of that works out. How bad is a 250 mile per gallon vehicle? It is enough, I would submit, to make Mr. Ahmedinajad, Mr. bin Laden and a whole carload of Wahabis frown a great deal.

Thank you.

DR. MESERVE: Thank you, Jim. There is now an opportunity for questions. The two microphones along the side.

DR. GANSLER: One of the things that we are supposed to be trying to address is the question of controls of science and technology. What you have described seems to me is something that is being addressed on a worldwide basis, or is more likely being addressed by other countries and not even us.

I wonder if you would talk a little bit about the question of how to treat this from a security and economic perspective. It seems to me that these are not things that necessarily should be controlled, but there is a sensitivity here.

MR. WOOLSEY: I think the objective here is rapid commercialization. These are all technologies in

which the Wright Brothers have already flown. What we are really talking about is being able to move from biplanes to monoplanes.

I think that we do need to do several things. First of all, in most of these areas further research is certainly warranted. It is battery technology, it is on reducing the cost of the biocatalysts like the enzymes. A lot has been done in those areas, but more could be, so this is not an area which is free of the need for research and development.

It is just that these four technologies I mentioned -- and the reason I picked them is because they already have been invented or are beginning in some ways to be commercialized. The main tool I would think would be encouragement by the government for a period of time until they get up on the learning curve of production, until one can move from Silicon Valley financing to Wall Street financing.

Several things would help here, two of which I think are politically impossible, but one should at least mention them. One would be attacks on either carbon or oil or gasoline, but the chance of adopting that in the current

circumstances are I think virtually zero.

A second would be doing away with all of the incentives which the current structure gives to oil. Oil has had a century or more to develop its own incentive structure. So whether it is the intangible drilling costs or the depletion allowance or not regulating the aromatics -- and I highlight to you Boyd and Gray's superb piece early this year in the Texas Review of Law and Politics on aromatics. Hundreds of billions of dollars a year of indirect subsidies going to oil because of the lack of regulation of those.

So one could say, we are going to level the playing field by getting rid of all of oil's advantages. Again, I think that is politically not a starter. So where one is left is tax credits and loan guarantees and the like for some of these new technologies, hopefully on as generic a basis as possible, so you don't have the government picking individual solutions.

Then a very good idea which Vinod Koshla has been suggesting, and Senator Richard Luger picked up a few weeks ago, which is a floor in the range of $35 to $40 a barrel under oil, implemented probably by tax policy, the

reason for that being that the two main occasions in the recent past that can make people very despondent about the ability for us to move out from under oil was in mid-1985 and again in the late '90s when the Saudis in each case dropped the bottom out of the oil market by increasing production from their reserve capability.

There is an argument that this will be much harder for them in the future, because no oil is peaking in the Middle East, and also because of the huge demand coming on line from India and China and the rest. But even if it is more difficult, it might still be possible. It would add a great deal of willingness on Wall Street to have financing at reasonable rates for these technologies if they were sure that the Saudis couldn't do what they did in the mid-80s and again in the late '90s with the oil prices. A floor below the level where all forecasts now go. I haven't seen a single forecast in the last couple of months that takes us below $40 a barrel. So if you put a floor below that, it might be politically more acceptable. If you could find some way to set any funds that were raised by taxation in the future aside for things like filling the strategic petroleum reserve or other energy or

environmental related purposes, it might be an added inducement.

So those are some of the tools of implementation.

The last thing I would say is that this is an area where all oil importing countries are potential allies. We have tensions with China. We have special tensions with China if we are elbowing one another about oil. It is in our interest on something like this that China move as quickly and decisively as possible, not to need oil, and I don't think they need such a big navy to protect their sea lines of communication, and so on.

So with respect to China, India, Australia, Japan, Europe, a large number of other countries, there is nothing in this for us in trying to be exclusive at all. The international cooperation with China and other countries ought to be the hallmark of what we do.

DR. BIENENSTOCK: What role do you see for the research universities in the approaches you have just described?

MR. WOOLSEY: The two ares I guess I would say, first of all, in cellulosic ethanol you do have now the

genetically modified yeast-like bug that Lonnie Ingram has done at the University of Florida, producing two of the three enzymes that you need to hydrolyze -- that is what ferments the C5 sugar in the hemi cellulose. Then you have it also producing two of the three enzymes that are used to hydrolyze the cellulose. That has been one of the things that has led people to be pretty optimistic about costs of enzymes.

But there is certainly room for further work on enzymes and on some of the pre-processing. Bruce Dale at the University of Michigan or Michigan State is doing a lot of work in that area, as is Lee Lind at Dartmouth. The whole panoply of moving the industrial processes and the chemicals and the genetically modified biocatalysts into useful and increasingly efficient productivity seems to me to be one very large area.

I don't know enough about the carbon composites to know whether more research is necessary on those or not. It is certainly worth -- I think the people who took the lead in moving us into that area were aviation, to have a look at how one could move carbon composites into relatively inexpensive production in industrial processes.

I'm sure there are more thermal processes for creating diesel from renewable sources than the one that I spelled out from Discover magazine. But one has a whole range of now very inventive small companies coming up with ideas about gasification of biomass, using the gasified biomass to produce sometimes ethanol, sometimes diesel.

I think that whole set of issues deserves the best that American science and engineer can bring to bear. You need somebody other than a lawyer history major to give it more focus than that.

MR. HART: Is there a way to internalize all the costs of importing oil, namely, the military guarantee of oil supplies from the Persian Gulf? If there were politically and economically a way to do that, wouldn't that make oil a lot more expensive than what the current market says it is?

MR. WOOLSEY: It probably would. It depends on how you would count the resources, what the opportunity cost is of having large naval deployments in the Persian Gulf. Would we have that size Navy anyway? I tend to think we probably would. And does one calculate only the cost of utilizing it in certain ways, or the cost of

procuring it.

But people who have done that type of calculation tend to come up with price of oil for us, or the cost for us being several dollars a gallon, when you look at all of the environmental problems and make the assumption that some major share of your military requirements might not be needed.

I can't remember the name of the think tank in Washington who has done this several times, but there are analyses of this that are quite detailed and precise.

DR. MESERVE: Jim, could I ask you a question about your assessment of Saudi Arabia? I have read that the House of Saud is not itself extremist, but has tried to buy off extremist elements by support of the Wahabis. If that is the case, Saudi Arabia may not be quite the lost cause that you indicated.

MR. WOOLSEY: A personal story. In 1978 I was Under Secretary of the Navy, and I was in Saudi Arabia for a couple of weeks, working on some naval issues with them. At one point through a friend of a friend I was invited to a Saudi home for dinner. The three Saudis who were there had been educated in the United States. Their wives had

been with them in the United States and had taken some courses at various places where they were. The dinner was for me and a friend, but the three men and their wives were there. The wives were in modest but attractive Western dresses. Everybody had an aperitif before dinner. Jazz was on the stereo. The discussion was sophisticated, about international affairs. Except for some aspects, it was very much like an evening I had in Israel about a week later.

I daresay that sort of an evening in Saudi Arabia today for a Westerner would be impossible. But I think what happened in 1979, not only was the Great Mosque in Meccasees, there were assassination attempts by Islamists on various Saudis that were thwarted, and the fall of the Shah and the replacement by a religiously fundamentalist Shi'ite regime, the Wahabis' great enemy, produced a situation in which in the kingdom what occurred is what George Schulz, not a man given to overstatement, and my co-chair in the Committee on the Present Danger, calls a grotesque protection racket. What he means is the Wahabis and the House of Saud cutting a deal essentially, in which the House of Saud gets left alone and the Wahabis

get all the funds they would want to go spread their views.

It is a loose analogy, and one always gets in trouble with historic analogies, but I think it is sort as if you go to the late 15th century Spain with Ferdinand and Isabella and Torquemada, her confessor, being the principal religious authority, and you move that Spain up into the early 21st century, and discover 25 percent of the world's oil underneath it. Ferdinand and Isabella now turn to Torquemada and they say, Torque, let me tell you, it is fine with us if you go running these Inquisitions in the rest of Europe, anyplace else you want. Go ahead and burn Jews and Muslims and dissident Christians and steal their money, fine with us. Just leave us alone, okay? And by the way, here is four billion a year, and Torquemada says, fine.

I think that is essentially what we have got since '79. Does it mean fundamentally that one can't get along with the House of Saud? No. There are reformers. There are other forms of Islam, not other religions, but other forms of Islam that are far more tolerant that are in parts of Saudi Arabia. But some key members of the House of Saud are very much aligned with the Wahabis, and the

Wahabis themselves.

I commend to you Schmuel Barr, an Israeli who has recently published a book on fatwas. If you want to know why there aren't very many moderate Muslims standing up and saying we ought to work with Christians and Jews and so forth, you just need to read the Saudi clerics' fatwas. Basically anybody who does that is effectively condemned to death as an apostate. No ifs, ands or buts about it.

DR. MESERVE: Thank you. Any other questions?

DR. BASHWA: Serata Bashwa from the MIT science, technology and society program. A question regarding how you see the time frame from the time in this crisis situation with oil and your prescriptions of these new technologies that will help us get to a future when we will be less dependent.

In the meantime, we are seeing tremendous conflict in the Middle East from the policies of this Administration and previous Administrations. How do you see this conflict resolved in the meantime?

MR. WOOLSEY: Well, the Mideast was not all that relaxed a place before we moved into Iraq. My take on the policies that have led at least in part to our being

viewed the way we are is that they have been a mixed bag, but they have generally communicated to the people of the Middle East that we don't want to give a damn about you, what we want you to do is be polite filling station attendants, stand up, pump the oil we need for our SUVs when we ask you, otherwise sit down and shut up and don't complain to us about these terrible governments that you live under.

Then we have taken several occasions to get started doing something, and then leave. For example, in 1979 our hostage rescue effort failed in Tehran; we stood down and talked. 1983, our embassy and our Marine barracks blown up in Beirut, we leave. 1993, shoot down in Mogadishu, Black Hawk down, we leave. 1991, we engage in the war against Saddam, throw him out of Kuwait, encourage the Kurds and Shia to rebel, watch them be massacred as we stop, and then leave. In the '80s and '90s each, on a very bipartisan basis, we regarded the whole thing as a law enforcement problem. You find somebody who has committed a terrorist act, prosecute them, that is all you really need to do. It doesn't hep much to prosecute somebody whose objective is to die, and to enter heaven and have eternal

bliss, and hopefully have as many people die along with him as possible.

So I think the combination of our retreats and our trying to deal with these Middle Eastern totalitarian ideologies by fighting with nothing has failed. It is nothing to tell people to sit down and shut up, pump the oil when we pay for it, that is all we are interested in. So we haven't had anything effectively competing for a long time.

I think that this standard in the Middle East could get very bad relatively quickly, worse than it is now. I think Iran is the heart of this, but it is certainly not the only player. So I think there is a great urgency about moving in these directions. We ought to take whatever incentive structure that Congress can come up with and the Administration, such as tax credits and loan guarantees, I think put a floor under oil, and try to move as smartly as possible into these technologies and the better versions of them that will come along as a result of work by people like people in this room, get them moved from high-risk Silicon Valley financing to Wall Street normal financing, where people can expect a reasonable

return and be reasonably sure that need is going to continue and not get undercut by Saudi oil production.

That is the way I see it.

DR. MESERVE: We are now going to go into recess for lunch. Before we do, please join me in thanking Jim Woolsey for some very interesting remarks.

(The meeting recessed for lunch at 12:03 p.m., to resume at 1:15 p.m.)

A F T E R N O O N S E S S I O N (1:15 p.m.)

Agenda Item: Export Control Policy in an Increasingly Competitive World

DR. GANSLER: One of the issues that we are clearly trying to address with the committee is that of export policy, how does that operate in a global economy, globally competitive economy, and in the presence of national security issues, which as we heard this morning can go from terrorism through rogue states through possible future peer competitors. In that environment of the economic and security issues, export security clearly plays a significant potential role. We also heard from the Department of Homeland Security, at least for the biotech area, he didn't feel that that was one that export control could have a significant impact on.

So this next session is now going to be devoted

to export control policy in this increasingly competitive and globalized economy. We are very fortunate, the Honorable Lincoln Bloomfield is going to be talking to us. Linc left the Administration in 2005, last year, after four years as the Assistant Secretary of State for Political Military Affairs, clearly a very important and very relevant position to this one. Linc had also had 12 years of previous government experience in the Pentagon, the White House, the State Department, so he has seen it from a wide variety of perspectives.

Linc, it's yours.

DR. BLOOMFIELD: Thank you, Jacques. Good afternoon, everyone. I hope you can hear me. I am very honored and pleased to be here speaking to the committee. Thank you for the invitation. I am delighted to join this distinguished group to talk about an issue that raises passions on all sides, because it deals with unfettered academic inquiry as well as national security at the same time. I am also very glad to be standing not too far from the Herman Building, where another Lincoln Bloomfield, Senior made his career as an educator, embracing both academic freedom and national security, and still serves as

professor emeritus.

When I took up my duties as Assistant Secretary of State for Political Military Affairs, there was a lot of criticism of the government's export control regime. It was loud, it was acrimonious, and the discontent was evident not only in the private sector, but among allied governments, within the U.S. government policy circles, and the Congress. It was universal.

You may be familiar with the critique that our system for regulating the exports goods, services, and technologies on the U.S. munitions list in particular is a relic of the Cold War, and should be fundamentally rethought. We hear this a lot. This point of view predates 9/11. It is still heard today, even though the champions of regulating exports the old way, the traditional way, have cited the threat of terrorism as justification for tightening controls even further.

I didn't come into the role as the Assistant Secretary as an expert on the regulatory regime for which I would be responsible, which is called the ITAR, the International Traffic and Arms Regulations. But I did read all of the reports from front to back, took notes on all of

them. I read all of the criticisms, met with groups who wanted to see fundamental change. I weighed all of their recommendations and created a process which was open and interactive. We had a dialogue, including through the federal advisory committee the reports to the Assistant Secretary, the so-called DTAG, Defense Trade Advisory Group. There were a lot of complaints, and there were some excellent ideas and suggestions.

Some of these became the basis of a package of policy proposals and recommendations that we provided to the President. President Bush chose not to proceed by the end of the first term with the new defense export policy. Perhaps he will see his way clear to doing so during his second term. I'll come back to that.

The essence of U.S. export control policy embedded in the law for well over a generation in the Arms Export Control Act is a national policy of restraint. That is the core of U.S. policy, restraint in terms of transfer of arms and weapons, weapons technologies, dual use capabilities to other countries. That may sound a little bit surprising to some observers, given that the U.S. is the major defense exporter in the world.

But unlike other governments, arms transfers are foremost a function of policy for the United States, not commercial interest. Obviously commercial interest exists, but policy trumps commerce in our system, which is why we are probably unique among nations. I may be wrong, but among the major military powers in the world, I am sure we are unique, investing the decision authority on arms transfers to other states with our Secretary of State, not with the military or with the civilian leadership of the Defense Department.

While the editors of the New York Times may decry the image of America as the arms supplier to the world, there is an annual editorial to that effect, you would be hard pressed to cite a recent instance of a major U.S. defense export falling into the wrong hands and creating severe unintended security headaches. We are more than a generation past the fall of the Shah.

There is however an unfortunate segment of the defense export market where fraud and unauthorized diversions of defense goods and technology occur. The question is, are we going about the regulatory function right? That is to say, are we enabling activity that

should be enabled and restraining activity that poses a risk to our national security.

Those of you who have ever been involved in an issue regulated by the ITAR may think of it along similar lines as the tax code, a very arcane, endlessly detailed series of specialized provisions. But it all adds up to a very simple proposition for the regulator who must enforce the ITAR. The government is obliged to know who receives an exported item on the munitions list and what they intend to do with it. It is that simple. Any later change in the end use or the end user of an exported item requires the prior consent of the State Department.

What that means is that our licensing bureaucracy should under law and regulation know where every single licensed U.S. munitions or good or service or technology in the world is, in whose hands it is in, and for what purpose. It is obliged to know this in perpetuity, for every change in end use and end user.

What is more, the government expects the American exporter for each of those license transfers to be held responsible for any unauthorized changes in the end use or end user of our military goods and technology. This

can properly be described as a risk avoidance regime. Among professional regulators in the executive branch, and there are more knowledgeable overseers in the Congressional staff and the general accountability office, people who know the ITAR and are familiar with it, the focus is in invariably today on tightening these rules, policing the system more diligently, covering all possibilities that exported goods might be turned to hostile use by our adversaries. Any thought of converting from a risk avoidance strategy to a risk management system of export controls will have to be introduced at senior levels, where the players can't be intimidated by accusations of being soft on national security.

What does a risk management approach bring to the process? The defining feature is discretion, which means the authority to say that some concerns are more important than others. I think the time has come to exercise much more discretion. Not only has the defense export licensing bureaucracy in my former State Department bureau nearly tripled in the past decade to over 120 people, but the number of license applications has grown from somewhere around 40,000 when I started in 2001 to an

estimated 70,000 this year.

A decade ago, commercially licensed defense exports consisted primarily of items, smaller weapons, ammunition, spare parts, that sort of thing. The vast majority of major platforms, ships, combat aircraft, large scale systems, would be handled by a government to government contract, which would be administered under the so-called FMS system by a Pentagon agency.

Today I would cite two important changes in that. Big weapons systems are now being exported under commercial contracts, through a State Department license, and a large and growing segment of exports are really not tangible goods, the kinds of things you could catch on a ship leaving one of our ports with a customs inspection, but we are talking now about data and knowhow often being exported between and among companies who are part of a multinational industrial regime of some sort, either an ownership regime or supply chain or a manufacturing arrangement.

So while the volume of export licenses has soared, the complexity of the issues raised by many licenses has also grown very significantly and slowed down

the approval process.

The reaction of a risk avoidance based system is to try to work faster, but ultimately the burden of assuring the security of these controlled exports is shifted onto the private parties involved through heavy disclosure requirements and the threat of severe penalties. That may sound familiar to the committee. No wonder there are frustrations among both the exporters and the regulators.

Take a look a the newest doctrinal national security pronouncements out of the Pentagon and the White House. The national security strategy of 2006 says that, and I quote, To succeed in our efforts, we need the support and concerted action of friends and allies, unquote. The Pentagon's 2006 quadrennial defense review says that, and I quote, alliances are clearly one of the nation's greatest sources of strength. These close military relations are models for the breadth and depth of cooperation that the United States seeks to foster with other partners around the world, unquote. That is our national security strategy today.

It is fair to ask whether the growing strategic

reliance on military partnerships is being best served by a rigid approach to defense trade controls that is manifestly driving key allies and partners away from our perspective on arms transfer policy, away from reliance on our defense industrial base, and away from importantly the legal and regulatory structures that might make it easier to establish collaborative technology development activities between our countries.

Add all these trends together and there is something to be said for devoting more attention and effort to the sensitive cases, and allocating less time and concern to end users who have used our trust, and end times whose potential for harming U.S. interests would be minor even if our enemies obtained them. We really should formalize a hierarchy of sensitivity within the management of the munitions list.

I realize that one issue of primary concern to this audience and to universities throughout the United States is not necessarily the province of the State Department, nor is it covered by the Arms Export Control Act and the ITAR regulations. I am speaking about the Commerce Department's responsibility for regulating so-

called deemed exports when a foreign citizen gains access to technology controlled under the Export Administration Act under a Commerce license.

I am not able to speak with any authority or knowledge about the non-military deemed export issue. What I can do however is offer you a senior policy perspective on the equities at play when our government weighs the concerns of universities, something that happened on my watch.

Thus far this afternoon I have spoken exclusively about one set of national interests, i.e., national security. America's universities represent a second national interest that is too important to be sacrificed in the name of national security, heretical as that may sound inside the Beltway post 9/11. I refer of course to the role our university system more than that of any other nation in recent times has long played in fostering the advancement of human knowledge through open, unfettered scientific inquiry and research.

The significance of this, the leading institutional engine of human progress on earth is difficult to overstate. You may be interested to know that

precisely this characterization was strongly articulated in my presence within the Bush Administration during the first term. Universities have a voice that Washington ignores at its political peril.

My question was and is, are the regulations imposed by the U.S. government impairing the capacity of our universities to continue functioning as the cradle of scientific progress. If the answer is yes, can we contemplate adjustments to the way we insure national security such that both these national interests, security and the possibility of human advancement, can better be served.

The operative issue for a group such as this is to determine which facts will be most relevant in assessing both the national security value of current export controls and the possible harm being done by their application to university activities. If the right questions are asked and answered, and if they point to a case for amending the regulatory approach, recommendations for change should flow from that analysis.

What specific questions are the right ones? In the case of deemed exports, I would demand that the

government produce data on demonstrable diversions of controlled military or sensitive dual use technology from the university setting to countries of concern. And supposing that a meaningful number of such cases can be documented, it is worth knowing whether holders of foreign citizenship are found to be at higher risk of migrating this sensitive information to hostile places than were American citizens with the same access. How do we know that Americans are less likely than non-Americans to do something with this information that the government does not like? Among foreign passport holders, can we really tell everything about a person's political orientation by whether he or she is British instead of Iranian or Chinese?

If this issue is truly impacting the potential of scientific inquiry in our universities, then you have a right to insist that any limitations be justified by real information, and not supposition or extrapolation based on a few problem cases.

A further question would be whether current technology control policies and regulations are making any difference in keeping controlled information within the university system from getting into the wrong hands,

because if we find that the interest of national security requires restrictions that inhibit this country's capacity to innovate and expand the frontiers of knowledge, we had better be sure that the measures taken are indeed the right ones to address the security problem. It is not worth the cost if it doesn't solve the problem.

In the end, what I am advocating is more than dialogue between risk avoiding federal export regulators and university executives who feel threatened by their sense that their traditional unrestricted activities are in some sense becoming a liability. What is really needed is a road map to establish some reliable facts based upon which the government can adopt sensible risk management policies toward universities.

My observation is that our export regulation bureaucracy is not staffed or configured to assist universities in insuring control over sensitive information. Our experts have far too much to do already in dealing with weapons exports and with clearly dual use WMD-related exports. When the government does not have the capacity to monitor university activities or assist in setting up compliance procedures, all too often it lays the

burden on the party being regulated, and uses the threat of serious punishment as a way to make the private party on its own initiative, meaning the universities, figure out how to reassure the government that its concerns have been answered.

That is probably not the optimal way to address the issue. Threatening universities is not a sufficient solution. We need to demand some facts on the existence of the problem, failing which, we need to challenge the government to study this issue rather than simply taking it on faith that there is a serious security problem here.

A responsible, unbiased study of this issue would pose some challenges for universities. Whereas in decades past, unclassified science and technology research in universities was intended for public dissemination, now we see the technology is a highly valued commodity, and some of the work within the confines of universities is proprietary, intellectual property that will not be freely shared in the public space.

We also sometimes find a nexus within universities between controlled defense technology and university research, as with scientific research satellites

that rely on defense contractors for launch services. Neither proprietary intellectual property nor the existence of ITAR controlled defense information diminishes the university community's valid concern that we preserve open scientific inquiry.

The fact that some countries engage in covert information collection activities within the United States is also of course a concern not to be ignored. But we need some facts. If there is a serious problem, you need some help from Washington, more than a threat of reprisals if universities cannot eliminate this risk on their own.

President Bush has in hand already some good ideas on export control policy submitted for his consideration by his first term team, that would advance our national security if he chose to add this area of policy to his legacy during his second term. A well conceived and coordinated approach to the Administration and Congress, setting out what is at risk at our universities and suggesting a period of impartial inquiry leading to recommendations that can be publicly debated would insure that busy security officials in Washington take full account of the great and vital role that our

universities play in keeping America in the forefront of science, and science in the service of America.

I wish you success in that endeavor, and look forward to your comments and questions. Thanks.

DR. GANSLER: Comments, questions? Non-controversial discussion?

Let me start off. The questions you raised were the kind of questions exactly we are supposed to be addressing in our committee. One of the concerns that a lot of us have had is that we don't hear them being raised within the Administration. Other than putting you back in that job again, what kind of solutions can you imagine us starting to get? Who do we look to to raise the questions that are exactly the ones we are being asked to address?

DR. BLOOMFIELD: My view is, you don't need to talk to anyone in Washington if they are not doing anything to you that bothers you. But on the assumption that university presidents and their administrative executive leadership are concerned that there is a cloud forming over university research that implies that there may be something wrong, harmful to the nation's security and actionable by Washington, then you need to react to that by

insisting on a fact-finding process.

You need to make them show that, for example, for any given population of foreign passport holders in the university environment, they are more likely than the American passport holders in that population and for that matter the public at large to compromise technology that they get their hands on, failing which, the dog is barking up the wrong tree.

I listened to the presentations this morning, and respect what it is like to stand in the shoes of someone who bears government responsibility and speaks for the President. I think there are ways of getting at this problem, and process is part of it, so I'll just give you my thought on that.

You don't need to go and ask the Department of Education about a national security concern inside universities, because it is not an education issue, it is a security issue. What you need to do is get to the security bureaucracy. This President, and each President has his or her own method of making decisions, right below the Cabinet Secretaries is something called the Deputies Committee. They meet relentlessly on all kinds of issues. They keep a

big bottle of Excedrin in the middle of the table, and they make decisions. When something really important to the President needs to be done, the Deputies Committee figures out a way to get it done.

I think that if the universities who are obviously very autonomous and pretty hard to put under one page, if you had one set of concerns, one set of recommendations, you would be justified in going to the deputy security advisor, and maybe going to the Secretary of State, who is after all a product of leadership in the university system, and insisting that there be a set of decisions regulated out of the Deputies Committee, such that they weigh the immense equities behind unfettered university research inside the United States, and don't trade it away without their eyes wide open for the benefit of security, and they have to make sure that the security bureaucracy proves its point that A, there is a problem, B, something has to be done about it, C, the measures that they propose are going to work and D, I would add, the burden shouldn't all be on the university to come up with some fanciful self-policing scheme, the government needs to help. I think the Congress would at least be generous in

helping universities put in place whatever infrastructure made sense to take care of the serious part of the problem, if indeed it can be shown that this problem exists.

So there are other aspects to this. Sensitive but unclassified, I'll give you my thought on that. It is like cooking for thousands of people in an industrial kitchen. I used to wash dishes down the road at Harvard for 1200 every meal. You can cook a meal for thousands of people, but if somebody needs a slightly better meal, you have a couple of chefs put a little bit fresher salad, they can fix it up.

So the point is, you don't care about most SBU information or for official use only. It is done on a very large scale by people whose names I don't know, who work in the B ring of the Pentagon two levels below the earth. So if they make a mistake, if there is something that really ought to be captured, that really ought to be disseminated, there should be a place you can go that takes a second look and says, yes, fine, take it, pull it off.

There should be a RECLAMA board for information. There is no magic to the first cut of classification in government documents. I have

classification authority. I used to do declassifications as a GS-9 in the Pentagon, and no one ever got promoted for giving away information. The only safe thing to do as a junior person in the bureaucracy is to make sure you never let anything out of the bag you shouldn't. So you are always going to say no and err on the side of caution. There needs to be a higher level place where a more adult supervision can kick in and free up the information.

DR. BRETON: Mike Bretton from Rutgers University in New Jersey. Two questions. One is, what happened in the first term? It is very refreshing to hear your comments and that this was put forward on a policy level. It is somewhat surprising to me -- I don't know how many others in the room knew this or the kind of detail you just gave us, I didn't, why was it ignored or not acted upon, not found to be reasonable? What you are saying sounds very reasonable to me.

The second thing is, given what we heard from Dr. Marburger this morning, there were many givens in his speech, and he would take it as a given that there are terrorists who could exploit the university environment and so forth. It is almost like he was asking us to take it on

faith that there is a problem. That seems to be diametrically opposed to your recommendation that we gather facts.

Is there any indication that an Administration like the one we are looking at would be open to a fact-based policy decision process, where we seem to have been hearing just the opposite, but you are advocating that?

I know those are two different questions.

DR. BLOOMFIELD: I'll go back to what happened in the first term in a moment, but if I were your advocate on this question, I don't know that I would assume that there is a lot of flexibility five or six years into a Presidential term, where there is a lot of agitation aimed at the White House. So they have probably got their defenses up, and they are not looking to be very flexible on information issues.

I would simply demand that before you do anything, I would say don't tread on me. Before you tread on university research, you have got to show something that is credible, that is actionable, that is seen to be such.

Now, do you declassify sensitive FBI information? Absolutely not, but there are ways to meet in

the middle. You could find three people of unimpeachable academic credentials who would be trusted by the university executive level nationwide, who have had security clearances in the past, to be re-cleared and to be briefed on sensitive cases of espionage and exploitation. Or not to be given all of the briefings, but to be given a sanitized version and let the government find a way to say something about this without giving up any information that shouldn't be released.

I am a believer that with a little bit of effort, you can communicate what you need to communicate without divulging details. It has often frustrated me that there is this false tradeoff between telling the people why something needs to be done, and why a certain condition exists, as though you can't do that without divulging all the details of sensitive or classified information. I have never believed that. I have seen countless instances where high officials on the fly have had to speak to a microphone, and they found a way to say what is wrong without divulging classified information.

So I would have to be persuaded that this conversation is impossible, and I don't think that is the

case. I think you could communicate where the problem may lie. I don't know if there is a big problem in universities. I know there is espionage, but my guess is it is aimed at more advanced industrial economic sites where things are at a higher level of development and being fielded. That is my guess.

Now, what happened in the first term? I don't know what predated me, and there are some officials here from the '90s who were there, but see if I have got it right, Jacques.

It looked to me like Chinese warlords of 5,000 years ago. There were big ancient walls around the acquisition shop which wanted to take the ITAR and tear it apart. The DTCA shop, which was Defense Technology Control, which was somewhat in league with the State Department's fiefdom, and that was being controlled in a very old-fashioned and slow and non-responsive way. Right so far?

We changed the management. We went fully electronic. We created four directorates where there had been one, so there were six high officials in place at one. One director turned into four directors, a managing

director and a deputy assistant secretary who was a policy official, Greg Soukanen, who still is today.

No one at my rank, including my predecessors or below, had ever set foot in the licensing spaces of the PM bureau, which are not inside the Truman Building, they are up the street. I made 20 trips there, but we brought Colin Powell and Rich Armitage and John Bolton was there, and we had several town hall meetings. In other words, we embraced these people and put them in the picture of what the mission was of the State Department, made them feel like they were part of something.

What happened is, actually I give credit to each office in the Pentagon, whether it was Mike Wynn's able leadership, Lisa Bronson as the deputy under secretary, Frank Miller in the White House and his able deputy, Maureen Tucker. All of them worked collegially. We did not have fights, we didn't. We agreed on just about everything. We found ways if we didn't agree on the fine detail, and the Commerce Department, Peter Lichtenbaum and his predecessor.

What happened was, on Capitol Hill at the staff level there was a perceived -- I think, I am guessing --

perceived threat that a change in the status quo would remove the immense power that the staff wielded. Because things would be more regularized, more transparent, the merit of the case would be more accessible to average generalists, smart people. You didn't have to pretend it was so impossibly arcane that only the lowest ranking member of the bureaucracy could possibly make the decision. We put some sunlight into this, and we briefed them on the Hill, and there was a very aggressive campaign against it, coming from Republican ranks in Congress, which it took Andy Carr to go to the Majority Leader and just put a stop, call a ceasefire for the 2004 elections.

So nothing against the recommendations. They could probably be improved on, but there they are. I think the President would be well advised and well served to dust them off and bring them forward.

DR. GANSLER: Relative to your comments about getting the facts, there have been conscious efforts made by a large group of people, including many that are here, asking for those facts. There were two meetings that I attended as a guest with university presidents, in which the director of the CIA and the director of the FBI in

separate meetings were asked to provide that data, and to date, even those of us who still have clearances have not been provided with that information.

So I think your point is a good one. You can find some horror stories. You can find them in any example if you look for them. But in terms of the kind of data that you are asking for, that has not yet been provided.

DR. BLOOMFIELD: I know there are more questions, but watch what happens when General Hayden starts his hearing on Thursday. The issue of what is the real story on data mining and all that is of concern to Americans and their representatives. See how much information is able to be divulged at the end of the day, and then ask yourself, suppose there are half a dozen cases of people burrowing into the university system at highly critical research nodes and trying to slip technology back to government-run organizations in countries that we don't feel too good about. Suppose there are a half a dozen cases. Are we going to lose the war on terrorism just by uttering any kind of generalization about the existence of such activity? I contend not.

DR. GANSLER: That is the balance. .

MR. HART: I have been engaged today in several corridor conversations about academic timidity and caution, the number of times people have said, our lawyers won't let us do this, meaning academic university lawyers. There seems to be a pervasive belief in risk aversion in the academy, what you are saying, don't think about it, don't try this project, don't get involved or the federal government will come down on you.

This isn't a question, it is an observation. I don't know what can be done to educate the lawyers in universities that essentially the processes you are talking about are open and accessible. What is happening, it seems to me, these observations are being made on a systematic basis, and that innovation in a whole variety of ways is being slaughtered in its crib by lawyers saying, you want to get in trouble with the DoD on this.

DR. BLOOMFIELD: I don't know if you could all hear Senator Hart's comment about the university counsels advising caution. It is an important point.

I think I would observe, I am not a lawyer. You see me affiliated with a law firm; that is a tribute to great negotiating skills, I think, billing time as a

lawyer, having skipped all the preliminaries. But in any case, I equate that as a high-level version of a mid-level bureaucrat. In other words, how many lawyers are going to get a raise and get ten more years on their contract if the university suddenly finds itself in a two million dollar compliance job, where its government contracts go away, everything is suspended, their prime faculty find another place to go.

Their whole point in life is not to let that happen. You need a higher place to make this case. They should be your advocate, but their job is not courage, it is advice. In the absence of the will to take this on, they probably will come out exactly as you say, Senator.

I think the answer to this is to have a collective voice and let the lawyers make the case, but don't just leave this bassinet on our doorstep. That is not a good enough answer from our government. You are paying taxes to the government in Washington. If this is such a darn important problem, then put some resources together, get a legal task force of counsels of universities, and put together a compliance program that will satisfy the government, so that they can say, as long

as that compliance program is there, we are happy.

Now, the terms of the program are highly negotiable, but until the government puts something on the table to shoot at, that is not the final word. We usually demand more from the government than simply to threaten and to coerce into intimidation. That is not a good enough answer.

Now, having said that, I tried to get defense contractor general counsels to lose a little sleep. Why? Because they are much more afraid of the Justice Department than they are of the State Department. I had the ability to debar their companies, to find them $10,000 or $20,000 per infraction, I have forgotten the ITAR already, but the point is that they could make me a lot happier if I knew that they were leaning forward, policing themselves, had some kind of regular checkoff and programs. I see this in the private sector already. That is a much better place to be when someone randomly knocks on your door and says, I want to take a look at this bio program that you have got going on here. With all of these foreign passports in the classroom, how do I know something bad isn't going on?

If you have some sort of a program where

independent people in the university with government metrics have looked at it, have weighed this program against certain security standard procedures that are already agreed by universities, that is a better place to be.

I realize how overworked the government is, which is why they don't have the right to claim, we are too busy, but I am going to put this huge cloud over you and you are going to suffer as a result. That does not serve the national interest of free and unfettered research, that has brought forward advances in human knowledge that no one saw coming. It is the whole possibility of the unknown that this university system brings not only to the U.S., but to the world. To impair that, it seems to me, is a step way too far, short of taking very serious steps along the way. It is on a par with national security in my book.

DR. GANSLER: In fact, the reason this committee got started was because of the exact example you just gave, of people showing up at the door and starting to put more and more increasing pressure. It is getting more so every month. That perspective that you have introduced I think is what we are trying to get to.

DR. SKOLNIKOFF: It seems to me and I think to many here that your outline of what is the right approach to take and what the university should do is exactly right, and the attitude towards the government.

One of the problems is legislation. The ITAR is a detailed piece of legislation. It happens to be self contradictory if you read it, which I for my sins had to do once, and it is very hard to make sense from the beginning to page 72, to page 153. The munitions list is a very fuzzy concept.

Much of what you proposed seems to me involves perhaps new legislation, or at least a kind of agreement on the munitions control and the ITAR, which would control new legislation. As you indicated to Congress, maybe the Congress as a whole is not likely to take this on as something that they get benefit from in the electoral process.

Is that a problem, or am I exaggerating it?

DR. BLOOMFIELD: No, it is a very good question. You have expertise in this room and on the committee about Congress. So what I have to say is less than your experts could tell you.

But if I had one complaint as an Assistant Secretary with respect to defense trade and defense export control policy, it was not that there was too much of a heavy hand of Congress; it is that the members were AWOL the whole time. The number of hearings where I was called on the carpet to explain a controversial arms sale in four years after 9/11 -- and don't forget, we renegotiated with Uzbekistan and all these others, was zero. No hearings. I got lots of calls from members who couldn't have been friendlier, could you help my company in a district, there is some kind of a licensing thing, I'll send you the paper. I always tried to turn that around very quickly and say, got you, yes, sir, we are here to help your constituent, very positive relations.

Therefore, operating in the dark -- and Congressional staff, often some of the most expert people who work not only with no recognition, but under the shadow of the famous member that they serve, I feel they should be more in the sunlight. I think if the staff are going to have the ability to put something on hold on their own authority, there should be a clock in it, the member should step forward and stand behind it.

So what we need -- there is nothing wrong with the Congress of the United States. We just need them to care enough about this issue to take it on. If you are talking to members, I am convinced that the kinds of equities that make sense to me or to you will make sense to them as well. And of course, you have a distinguished former Senator here who can give you his view if he has time. But my own view is that you will do much better than just talking sense to members of Congress, and come out with something that is workable, as opposed to letting it -- there is a lot of leverage that takes place in the dark if the members aren't involved. That is very negative.

So that is what I would do.

DR. GANSLER: You have to be a little careful, though. You might get some unintended consequences out of the Congress. Obviously some recent steps, the Buy America Act, for example, things of that sort go counter to some of what Linc is talking about. So you have to be very careful. There are 535 opinions there, not always in agreement.

DR. BLOOMFIELD: But both years that legislation was pulled down, it didn't pass.

DR. GANSLER: It passed the House.

DR. BLOOMFIELD: And it had to do with who gets to do defense contracts, which doesn't always warm the cockles of peoples' hearts. Whereas, advancing human knowledge puts it on a higher plane, frankly.

DR. GANSLER: Absolutely. Last question.

DR. BIENENSTOCK: I just wanted to set the record partly straight based on Senator Hart's remarks about the lawyers. In the case of deemed exports, the AAU and COGR formed a task force of university presidents. They met regularly with Department of Commerce officials, either the presidents or their designees.

They strongly requested that a group of them that have had clearance be given evidence. My understanding of the evidence that was presented was that it was underwhelming, but as a consequence of that, we have seen -- partly as a consequence of that, that Commerce is going to look further into the thing and not go forward with the proposed regulations.

So in that sense, the system was working effectively. Both the universities and Commerce were open to a dialogue to seek to resolve the problems, and there

was no lawyer-based timidity on the part of the presidents. The timidity is related to other issues, but not to these fundamental issues.

DR. GANSLER: Lincoln, thank you. Gary, if you and your panel would come on up now.

Agenda Item: Panel: Key Indicators/Sectors (Role of Academic Research)

MR. HART: Some of you will not be surprised to know that I intend to proceed a little differently here. I want to introduce the panel very briefly, have them make their remarks hopefully in ten and no more than 12 minutes, reserving a few minutes at the end of the 2 to 3 o'clock hour for comments and questions between and among the panelists. We will break for a brief period of time, come back and open for questions. But we will start with the committee first, and then open it up to the broader audience here.

The biographies of this panel are contained in the committee's information, and are so vast in their experience and accomplishments that we would spend a good part of the hour going through those bios. I will simply use a one-line introductory identification contained in the

program today.

Working from my right to left, a process I like very much, we will first hear from Professor Richard Lester, professor and Director of the Industrial Performance Center of MIT, one of our hosts here today, for which we are thankful. Professor Ernest Moniz, a professor of physics also at MIT. Professor James Baker, Director of the Michigan Nanotechnology Institute for Medicine and the Biological Sciences at the University of Michigan. I am told that at the conclusion of his presentation, to demonstrate his virtuosity, Professor Baker will before our very eyes reduce himself to a thinking, breathing single-cell organism.

DR. BAKER: Might be an improvement.

MR. HART: Last but certainly not least, Professor Gary LaFree, Director of the National Consortium for the Study of Terrorism and Responses to Terrorism, START, at the University of Maryland.

So let's begin with Professor Lester.

DR. LESTER: Thank you very much, and good afternoon, everyone.

My assigned topic for this panel was innovation

indicators, which in the context of this discussion really could have meant a number of different things. As I thought about how best to prepare for the session, it occurred to me that one possible topic had to do with my responsibility for graduate admissions to the Department of Nuclear Science and Engineering here at MIT.

This has been quite an interesting year, in which the list of countries from which students were applying to study nuclear engineering included such staunch allies of the United States as Mienmar, Venezuela and Yemen. It has also been a year in which the federal government, struggling of course with the problem of Iran and at the same time looking for ways to promote the use of nuclear power around the world without contributing to the spread of nuclear weapons, has moved further than ever before down the road of trying to divide the world into nuclear fuel cycle haves and have-nots, as distinct from nuclear weapons haves and have-nots, the old distinction, while at the same time increasing the focus on research and development of relevance to research universities like this one is fuel cycle areas that could be deemed sensitive.

So here is a genuinely difficult problem of

finding a balance between national security and energy security, in which we in the universities are unavoidably engaged whether we like it or not in national policy questions. There may in fact be an opportunity to take up this particular issue in the discussion period. Indeed, my fellow panelist, Ernie Moniz, may also be taking it up in his remarks.

But instead of focusing on that issue, I decided instead to focus on a different topic, the one that is almost as relevant to the subject of this conference, which is more closely related to the other hat that I wear here at MIT. That is the issue of economic competitiveness and the implications of globalization, which I will define here as that set of changes in the international economy that are leading toward the creation of a single world market for wages, capital goods and services.

The problem of globalization is only indirectly related to the government-university partnership for science and security that is this committee's brief, but it is obviously relevant in the sense that it is shaping the environment -- among other things it is shaping the environment in which America's research universities

understand and carry out their mission. As a matter of fact, it is probably having a greater impact on what universities are doing even than the changes in the national security environment.

One of the questions that this committee is addressing is, can we afford a national security policy that doesn't address economic security. The obvious answer is that we can't. If we want to try to understand the relationships between national security and the university enterprise, it is also important to understand how that enterprise is being affected by global economic competition. I want to mention a few points in this regard.

There is of course a growing focus on the role of universities as engines of economic development, engines of innovation and so on. In many ways, there is nothing new about this, but certainly the emphasis on this aspect is more pervasive than at any time in the recent past. It is not really surprising. Universities are a key source of the most important assets in a knowledge economy, educated people and ideas, and especially when you look at it from the perspective of local and regional and state

governments, the best thing about universities is that unlike almost every other actor in the economy, they can't move. They are necessarily committed to their region for the long term. University administrators have welcomed this new attention, in part because of its promise of new revenues at a time when traditional sources of income are under increasing pressure.

So what can we expected from these institutions, and what should they expect from themselves? And how will we know whether these institutions are succeeding, and what are the implications of success for the national security issue, as well as of course for the primary missions of education and research?

Let me make a couple of points about this. First of all, there is a model of success. We can think of it almost by now as the standard model, that has been strongly influenced by the examples of Silicon Valley, the Greater Boston area here, and a few other places.

It is a model which starts with discoveries in the lab, proceeds through disclosure and patenting to licensing of intellectual property, frequently to early stage technology-based enterprises founded by the inventors

themselves. The image evoked by this model is one of a stream, in the best case a torrent of discoveries flowing out of university laboratories with companies happily fishing in the stream for knowledge that they can turn into commercially exploitable products.

There are enough successful examples of this kind of thing that its importance seems clear. But its importance also is sometimes exaggerated. For example, the number of university related startups is in fact a very tiny fraction of the overall rate of new business formation, and similarly the number of patents granted to universities on an annual basis is also a very small fraction of the total rate of patenting.

Now, of course this is not to say that university related patenting and new business formation aren't important, but it does make clear that we need to keep these things in perspective relative to the growth and job-creating capacity of the economy as a whole.

Second, the expected return to universities from their licensing activities is low. For U.S. universities as a whole, licensing income is only a small fraction of research revenues, and of course there are a

few highly remunerative licenses, but the probability of an individual university striking it rich is very low.

Of course, this kind of technology transfer has other important benefits beyond income, for example, the boost it gives to the entrepreneurial culture on campus, which often is the key lacking ingredient. But in the main it won't transform the finances of the university.

Third, despite the current emphasis on patenting and licensing, this is of course only one of many ways in which knowledge flows out of universities into industry. Publications, conferences, consulting, informal interactions of various kinds, and of course training and hiring of students may all be in specific cases more important.

So clearly, it is important to have a more holistic view of the economic role of the university than is implicit in the standard model, one that highlights nonproprietary as well as proprietary knowledge flows, and more generally one that pays attention to other dimensions of that role, for example, as a source of human and social capital as well as new knowledge, as an interpreter of technological knowledge as well as a source of it, and so

on.

One of the roles that tends to be underestimated here is what I have come to think of as the public space role. Recent studies of innovation have pointed to the importance of sheltered spaces in our economy, where open-ended interpretative conversations about the directions of markets and technologies can take place. But many of the traditional spaces in our economy that serve that role, places like Bell Labs, IBM Central Research Laboratory and so on, have either been in some cases shut down, but in other cases redirected toward the shorter term needs of the business units. This in turn has created the need to expand such spaces outside industry itself, in other words, public spaces for interpretative activity are becoming more important. In our economy, the most important public space is the research university.

The conversations that take place in these public spaces between and among university and industry people are very rarely about solving specific technical or commercial problems. But they often generate the ideas that later become the focus of problem solving in both industry and universities. As I said, their importance is

usually underestimated.

The next point I want to make about this is about the changing character of the industrial innovation process. If we ask today what can we do as a society to try to insure that our lead in innovation doesn't dissipate, and to try to make what we all recognize are increasingly mobile innovation activities stick here in the United States, the most important answers to that question are the same answers we would have got if we had asked the same question 50 years ago: Investment, investment in education, investment in research, investment in new technologies and new ways of producing.

The second most important answer is to cultivate a generalized willingness to take risks, which of course in turn requires a sense of confidence in the future and in one's own abilities. That too is not a new insight. Maynard Keynes highlighted the importance of animal spirits for economic growth 70 years ago.

But the way in which innovation takes place, the work of innovation, has changed radically in recent decades. The rules of the game are different, and in that sense, the answer to our question has also changed. We

know that products and services today tend to be more complex, that they are more likely to embody multiple technologies, and that they are more likely to be closer in many cases to the frontiers of science. We know also that product life cycles are shorter, that speed to market is faster, and that production networks have themselves become much more complex and fragmented and spatially extended. We know finally that these changes imply greater reliance on external sources of knowledge, even for the very largest firms.

There is no single product that encapsulates all of these changes. I know that someone earlier today referred to the iPod example, which certainly captures some of it. But the general point is that whereas innovation and production used to be carried out mainly within a company's four walls within a single national boundary, now they typically entail activities at multiple sites around the world and carried on by multiple independent organizations.

These changes are posing new challenges for the people engaged in innovation. They demand new skills, new ways of thinking, and maybe most important, they put

greater focus, or they require greater focus on the extremely difficult work of interaction across technological disciplines, across corporate boundaries, and across national borders. That in turn has important implications for what we do in education and research at places like this.

For example, our graduates will increasingly need to know how to locate and how to access resources in disaggregated value chains around the world. They will need to know how to coordinate dispersed activities and work with partners in production and innovation from very different backgrounds from their own. They will need to know customers and markets both in the United States and of course increasingly in potentially enormous markets like China and India and others. This will probably mean making international research or international internship experiences an increasingly integral part of the education that we offer.

We also will need to work very hard and increasingly hard to bring the best and the brightest students and faculty from elsewhere to our campuses, because they will be an asset to us and to American

industry. There has been a great deal of attention paid and a certain amount of hand wringing about the large numbers of overseas students in our science and engineer programs, but in fact, the continued presence of the best of these students can no longer be assumed. They have more options now, whether at home or at universities in other countries that re competing hard to attract them. For those that continue to come here, whereas many of them used to stay, there are indications that a growing proportion of them are now going home to take advantage of attractive professional opportunities that increasingly are available to them. We are going to have to work much harder than we have in the past to bring these people to our campuses.

Finally, just by way of a concluding comment, the obvious point here in all of this, and I certainly could have said much more, is that the differences that stimulated the formation of this committee, the fact that universities and businesses need the free flow of ideas and knowledge while government needs to keep its citizens safe and to prevent weapons or knowledge of how to make weapons from falling into the hands of the wrong people, these differences and the tensions that are implicit in these

differences are likely to grow more rather than less pronounced as time goes on. We must assume that the security imperatives of the government will become more challenging rather than less over the coming years and decades, and at the same time it seems likely that the importance of the university's role as a public space in an increasingly globalized innovation process will also grow.

This is a tension that we will have to find a way to live with. There is no silver bullet that will allow it to be finessed or that will make it disappear. But there is also no reason to over complicate the situation, either. It is a fact of life, and the things that we will need to do to manage it are the same things that we have to do whenever we have to deal with systematic differences, make sure that the lines of communication are open, educate ourselves about all sides of the argument, and recognize that where we disagree, it is not because one side or the other is bad, but rather because we have different views about how to achieve what in the end are surely the same basic goals of prosperity and security for our society.

Thank you.

MR. HART: Thank you very much, Professor Lester. Now on issues relating to energy, Professor Ernest Moniz.

DR. MONIZ: Thank you, Senator Hart. I think I have been assigned the task of making some remarks on energy science and security. My intent is to do so, but probably only pair wise among those words. I'm not sure all three will ever feature into the same remark.

I'm going to start with discussions around what I will call for reasons that will become clear later conventional energy, the energy one is probably thinking about in these remarks, supplying electricity, transportation fields, et cetera, which of course is a multi-trillion dollar a year business. The world runs on it. In general, as we will discuss, the knowledge per se, a chemical flow sheet is not exactly a national security threat in and of itself, but there are issues of competitiveness, there are issues of student training, there are issues of some of the enabling technologies and facilities potentially falling under deemed exports, et cetera. But that is something you will all discuss, I will not offer solutions to that problem.

So let me first start by enumerating -- we heard a little bit of this this morning by Jim Woolsey, but let me start by enumerating what I would consider to be first of all the energy and security issues. Those are basically the issues surrounding oil and natural gas supply, especially oil, where the underlying issue is the inelasticity of the liquid fuels transportation market.

The second is the issue of protection, liability, resilience of the energy infrastructure, energy delivery systems. The third are the issues surrounding nuclear power and its potential association with nuclear weapons proliferation. The fourth is the possibility of energy environment driven substantial societal dislocations, as for example might be the case with climate change.

Let me parse those a little bit more and try to work in the science part of the equation. First of all, many of you know here at MIT we have a major focus driven by our President, Susan Hockfield, in energy. Similarly, many other campuses are increasing their focus on energy, Stanford, Texas, Georgia Tech, Purdue, I could go on with the list, the only point being, this research area if

anything we are going to see much more intensively pursued at universities than has been the case frankly over the last couple of decades.

So if we look at what these security issues entail, let's go back to the oil issue and the inelasticity of the fuels market. There are basically three general kinds of responses. One is a response to disruptions, like the petroleum reserve. Jim referred to that this morning. It is not a particularly technology intensive arena.

But there are two other areas. One is to increase supply, preferably in a diversified way. That includes things like enhanced oil recovery, learning how to extract oil in difficult environments like the Arctic ultra-deep waters, areas that cannot include the Middle East, and finally, unconventional oil, things like tar sands in Canada, once again a huge reserve in principle, but one that takes some effort to extract, particularly in an environmental friendly way.

Two comments on that. One, these are really technology plays. There are huge amounts of science and technology to do here. We will be working on those. One factoid that came up in a seminar a few weeks ago was that

-- I may get the numbers not quite right from memory, but I think it was a statement that last year in the United States, there were 17 Ph.Ds in petroleum engineering, and less than five U.S. citizens. So you can draw whatever conclusion you wish, but that maps out some of the space that Richard was talking about particularly in this area.

Then the third general area of response is to reduce demand for petroleum based fuels. That includes efficient vehicles, we can go through the list again, hybrid cars, whatever you want, but there is that, and alternative fuels, oil, natural gas, biomass derived fuels, coal and biomass being of particular interest in the United States, and a third, moving to a transportation system based upon energy carriers as opposed to primary fuels, specifically electricity and possibly hydrogen. This morning we heard the word hydrogen highway used, and that raises associations of the paving with good intentions. We won't follow that too much more, but certainly moving to electricity would be a major dislocation in the transportation system, with major benefits for security.

So again, for the purpose of our discussions here, these are all areas that are clearly technology

intensive. Universities do have and will be seeking to offer much in resolving these problems. They do not raise the knowledge base security issues, but they raise all these issues in terms of the kinds of technologies that would be required. For example, advanced simulation, we believe, particularly in the university environment, will be a major novel contribution to many areas of energy development, and that obviously has the association that has been much talked about.

Protection of energy infrastructures, another area, issues of resiliency, of extended networks like grids is a high technology arena of the same type as before. I will skip the fourth, the issues of dislocation like climate change. Once again, the same kinds of issues. There, the technologies are efficiency, carbon-free energy and carbon sequestration.

The fourth area, the one that I skipped over, is one that does raise direct national security issues potentially, Richard alluded to it, and that is nuclear power and proliferation. We see that being played out today especially with regard to Iran. But the issues should be noted here, and will need probably some special

attention.

One reason is that certainly in the United States, the major move now towards greatly expanding nuclear energy R&D, an area that has been rather modestly supported for quite some years. The Administration has made a major move to start a new R&D program with international partners. It is focused on advanced fuel cycles that recycle all transuranics.

The principal reason in favor of this kind of work is that in principle it may if you like break the back of the nuclear waste management problem, but one should also understand there is a very fundamental link between waste management and proliferation vis-a-vis where the transuranics go. That is, the transuranics dominate the very long term post millennium waste management problem, so removing them from the waste is good for waste management. However, they are also the isotopes that work in nuclear weapons, so removing them from the spent fuel, you pay the price on the proliferation side.

The bottom line is, if we are going to have a major program, much of it at national labs, but certainly much of it at universities, MIT for example has a

partnership with the Idaho National Laboratory in which we and other universities will be working, you inherently are getting into issues of understanding chemical separations, possibly metallurgy, dealing with transuranics, more likely surrogates in the actual work done, but the whole point is, the surrogate is giving you the fundamental capability to understand this kind of business. When Richard tells you how many of the students he admitted were U.S. citizens, this particularly will raise issues going forward that are best addressed up front rather than only after problems start.

I believe that among other things, maybe my only one specific recommendation will be that on this particular problem, starting to get into classification guidebooks would be a very healthy thing to do, as opposed to just dangling forever with sensitive and unclassified and every other possible name you can bring to bear on things you can't quite argue why they are classified, but nevertheless just want to do something about. If this is left at the lowest level of decision, you know where the argument will drift.

Anyway, so that is the one issue among these

conventional energy and security areas that certainly will need special attention, as apart from the deemed exports kind of discussion that will apply more generally.

Let me finish by turning now to what I would call unconventional energy in this context, but of direct interest to some of our new national security requirements. This is a post 9/11 discussion, not that the problem wasn't there before 9/11, but I think we failed to notice it very much before 9/11.

As prologue, let me just remind people, we are now in this period of terrorism of international reach, but let's not forget the very significant intersection of academia and national security that in many ways shaped our current research support system coming out of World War II in many ways, cryptography and radar and nuclear weapons. Radar on our campus, the Rad Lab, which grew into the Research Laboratory for Electronics, which still exists, I would say that not only was that a major contribution of academia, MIT and the collection of scientists who came here from many universities in that work, but it also shaped permanently -- well, permanently is too strong, for at least 60 years by observation it has shaped profoundly

the way research is done on this campus, in terms of being something that pushed multidisciplinary work across the institute.

Similarly, the whole industry focus for basic research coming out of World War II, a very, very important intersection there that to this day, the plurality of research support in the United States all came out of that security driven system that I would say was focused certainly for the physical sciences, focused on miliary capability.

However, particularly post 9/11, our view of national security needs and science and technology needs certainly go beyond military capability to include things like homeland security and counterterrorism. The research needs in those three areas can be quite different. Specifically, since we are talking about energy, let's talk about energy in those areas.

A slight caricature, but let me make it to be simple. First approximation. Much of the energy requirement for homeland security is not a particularly interesting research challenge. Typically you plug something in. That is a little bit extreme, but not so

much.

In the military capability arena, energy remains important. We have seen more of it in the news recently, the Air Force wants shale oil and a few other things. Efficiency is very important. It can help logistics, it can help war fighting. But frankly, again it is more or less conventional energy with a special application.

Intelligence however in many ways you might say is the cutting edge for energy related research, national security. The requirements are probably not what is going to take over the mass market. It might be very, very low power, requiring no maintenance for long times in hostile environments, perhaps delivered in unconventional ways, and preferably with a broadband communication capability to boot.

These are actually very, very challenging science problems. They may have application in the long term in more conventional applications. In fact, the is may be the classic way of introducing a brand-new capability. Clearly the nano world is brought to bear, but in addition there are things like harvesting environmental

energy, shall we say. These are areas by the way that certainly in MIT, I'm sure elsewhere, I know MIT better, these kinds of core enabling science go on here.

Many are not aware, but in the last few years there has been a specific program jointly put forward by odd bedfellows, the intelligence community and the National Science Foundation, supporting work in universities, completely open, in some of these enabling technologies; how do you get energy out of a grape or other things, for example, that may be lying around.

So this intersection is very important. It is clearly going to lead to some challenges which have not really yet been faced. That is, the issue of what do you do with success. Failure will be no problem; it will just be a paper. But the question of how the IC and the universities for example manage a transition from that research to what would be classified applications still remains to be worked out. I think that is another example of an interesting and novel problem that is now developing quite far away from the conventional energy challenges, but one that is very important. Energy enables all these activities, including this kind of very special assistance

in the intelligence world.

Thanks.

MR. HART: Professor Moniz, thank you very much. Now Professor James Baker on the fascinating subject of nanotechnology.

DR. BAKER: I'm a little bit different from the other academics, in that I have a different history. I won the Trapp lottery in 1971 as a freshman at Williams, 003, and wound up on active duty for 14 years. I was an internist at Kimball Learning Hospital at Ft. Meade.

What I would like to do is give you examples of nanotechnology that are from our universities, try and give you a perspective about dual use applications and why there are concerns about this.

I will start out with slides from my colleague, Dr. Rocco, who is head of the NNI. The NNI is to a great degree a response to international activities in nanotechnology and the concern that we were left behind in this.

Basically it is a materials science program. It is looking at the foundation of matter in terms of understanding control and transforming matter, be it

biological or non. There are long term societal implications for this. It will fundamentally change the way we do things, and I'll give you examples of that. More importantly, this is a transformational science, because it is truly cross-disciplinary to begin with.

To give you some idea, our institute has a physician as a director. The director of our applied physics program is number two, and an optics scientist from engineering is number three. So this is really cross-disciplinary at its core. These are the types of things that fundamentally change science policy as well as education in universities.

If you look at the goals, they are increasing complexity in terms of technology and application. In the first generation of materials, nano particles, nano structured metals, ceramic surfaces were about 2001 out. We are now finishing the second generation, and I'll give you examples of both of those. This will move on to systems, integrated materials that are on the nano scale certainly smaller than our ability to identify them by traditional means. Finally, who organisms, whole molecules. We joked about turning ourselves into single

cells, but in fact, we are looking at making entirely smart systems that can function independently, but still have size ranges that are unique.

Let me talk about specific applications and how these are being co-opted in universities for advanced purposes, and how they might be viewed as somewhat disconcerting to people.

Electronics. The whole post-silicon molecularly based electronics program are nanotech. I'll give you examples of what these will do, but they will fundamentally change how electronics mediate, both in terms of ability, speed of switching and energy levels. You will get much lower energy utilization, much higher density circuits, and you can imagine these as components of either cars or weapons.

Coatings. One of the places this is most important has been coatings of different materials. We are actually now using these, and DoD is buying them as blast and munitions resistant coatings. You can imagine body armor that is made out of simple polystyrene that is coated with nano materials, the type of revolution that would make for both us and our enemies. These are also surfaces that

self decontaminate, and would resolve many of the issues involved in bioterrorism.

Energy is another area that is a major issue. There is reduced utilization of energy through reduced bulk. There is increased storage density because of nano structuring the materials that hold things like hydrogen, and there is more efficient conversion. You can imagine nano structured batteries are much more efficient in converting energy, much lighter and able to accomplish better things.

When you look at the power examples here, what you see is fairly remarkable, because it jumps Moore's law again. This actually will reduce by orders of magnitude both the power dissipation on the X axis and the switching time on the Y axis. So we are really talking about a total field change in nano electronics.

In analytical sciences and modeling, what we are going to be able to do is analyze nano structures, even the parts of our bodies, the proteins and other things, on a single molecular basis and tell what they are. We are going to be able to control the structure of materials in a way we have never been able to before. We can assemble

things involving both biological and synthetic components into materials that can interact with both.

Finally, detection. One of the big concerns probably inappropriately are concerns about contamination from nano materials. One thing that is for sure is, many of the particles that we are making avoid our own detection because they are below detection limits.

If you look at the types of self assembly materials that we are looking at having control on, I give examples here in honor of MIT, from two groups from MIT, Angela Belcher's work, where she uses bacteria is a template for nano wires, Dr. Bwendi's work for several different types of quantum dots, that give you an idea that this material is so small and so well structured that most of the techniques we have right now can't really define it.

Bringing this home to my own realm, I am going to talk a little bit about biology and medical applications. In terms of research, as I suggested, we can now look at parts of the body in real time, structures within ourselves that we haven't been able to investigate before. I'll go into that in a minute. We have new ways to diagnose disease real time to understand what is going

on, but also get a feeling for where people have been, what they have been doing, what they have been exposed to, and therapeutics that are specific for diseases, or can be used as specific toxins or other delivery systems, are also something that is now capable.

If you look at why nanotechnology is important for biology, it is not because we are making little robots that will go in and fix ourselves; that violates the laws of physics. But biology is a nano science. If you look at the realm from one to 100 nanometers, which is defined as nanotechnology by the NNI, all of the structures we have in nature are within that. Although we have done a wonderful job with molecular biology, defining our component parts, and a very good job with histology and histopathology, looking grossly at this function, we don't really know how the parts of biology work, the flagelli, the mitochondria. We can't look at them real time up until now unless we freeze fracture the M. So we are going to have a vision into how biology works that we have never had before.

The other thing is that when we make particles on this scale, they have different roles in biology, merely because of their size. You can tell that most of our

component parts, be they proteins, be they nucleic acids, or even the bigger structures like histones are on nano scale. So we can make synthetic materials that can interact one on one with our biological components in ways that are unique.

Let me give you two examples of this to finish up. The first are nano particles as therapeutics. There are many different types of nano particles that are therapeutics, polymers like fullerines, gold particles, even starch can be nano structured. We have done synthetic polymers called dendromers. These dendromers are somewhat like synthetic proteins, in that they are the same size as our proteins, but they are synthetic, so they can get into the body and do certain things.

One of the things that these particles do that is very different from the same type of material larger is penetrate the body in ways that it can't before. For example, these particles can cross the skin in mucous membranes just by getting in the pores in the hair shafts. So in fact, without applying things through needles, we can get material into the blood, across the blood-brain barrier into places we haven't been able to reach before. This

gives us tremendous capability.

We have developed vaccines based on nano particles that penetrate the nasal mucosa and induce an effective immune response, which are very high titre antibodies in cytotoxic immunity, as compared to the same material that is not nano structured.

For example, here is a mouse that has been infected with smallpox. You can see in the upper panels, this is vaccinia, that the mouse gets progressively more infected. The colors represent the replication of the virus. Whereas, the mouse that has been immunized only once with this nano particle vaccine is totally protected. This is a wonderful application, but you can also understand the concern that this would be hooked not to a vaccine but a toxin and be able to get into peoples' brains or other components without the protections that our skin normally provides.

Another application is delivery to tumors. One thing that we would like to do is specifically target tumor cells and not affect normal cells, so people don't get sick the way they do with chemotherapy. The big barrier to this is size. You need to be less than 20 nanometers to get out

of the blood vessels and get to tumor cells, and you need to be less than 150 nanometers to enter tumor cells.

We have been able to target drugs to mice. You can see here that as compared to the mice on the left that have gotten the traditional chemotherapy that isn't targeted, they have lost their hair and lost a third of their body weight because of it. Mice that get the target chemotherapy have dead tumors, but otherwise are healthy.

In fact, you could use this to mark tumors. In the upper panel, a tumor that has a certain receptor will light up with this material, whereas the tumor on the other side that doesn't have the receptor doesn't. So you can mark certain parts of the body for different types of application or, as I suggested, you could use these as a means of marking an individual to find out if they have been in the wrong place or the wrong time or the wrong country.

What is the potential for this just in biology? We are talking about smart therapeutics that can target and obtain imaging and accomplishments that we can't do with normal drugs. Molecular surgery; we can hook these to metal particles and knock out a specific protein in the

cell by hitting them with the right wavelength of light, and knock out an oncogene without affecting the cells. Unfortunately, people have talked about using these for death rays by targeting the wrong protein in a cell and hooking it up for that.

Remote real time medical monitoring of people that are ill or soldiers out in the field that might be exposed to things. Having these smart molecules, we can set up sensors across a battlefield that can report back, and do it so efficiently that they don't need their own source of energy. Functional augmentation, which scares a lot of people, but if we can get things into cells that augment their mitochondria, we can increase energy utilization, bigger, stronger, faster. Finally, brain monitoring. Intent is an important thing, as they suggested today and we have no real physiologic correlates of that other than the traditional lie detector. If we could do this, I think it would be unique.

We can understand why people are concerned about this being dual use. Our universities lead the way in this, but we also have to understand the implications for this research.

Thank you.

MR. HART: Fascinating stuff. Professor Gary LaFree on the social sciences.

DR. LaFREE: I am the Director of the National Consortium for the Study of Terrorism and Responses to Terrorism, the START Center. It is the fourth center of excellence that has been funded by the Department of Homeland Security. It is the one that is most closely related to the social and behavioral sciences.

It started with an initial $12 million three-year grant. A lot of my comments when I was preparing my address I think have been covered in an interesting fashion in different ways this morning. But what I would like to bring to the late afternoon discussion is a view from down in the weeds.

Because our center has been up and running for about a year, we have already been having to deal with particularly the sensitive but unclassified issues in an ad hoc fashion, because there is no one policy. So what I would like to do in ten, 15 minutes is talk about three things. I thought it would be useful for the committee and the group here to see what it is like on the battlefield,

the everyday university center world that is dealing with these issues, so I thought I would give you a little bit of a feel for what our center looks like. Then I thought I would offer several general concerns from the social science standpoint about imposing new levels of classification on university research, particularly in the sensitive but unclassified area. Then I thought it would also be interesting for the committee to see how we have started to put our own band-aid approach to what to do in the interim before there is some sort of a policy.

We have been in this interesting situation. I have talked to the DHS people, and they have given me two bits of advice. One, be proactive on this issue, two, go slow on this issue. So I thought it would be useful for the committee to see how we have responded to that.

First with regard to how we are structured. This grant was originally aimed at doing three things. Our mission statement looks at the formation of terrorist groups. We look at why individuals join terrorist groups, the psychology of joining a terrorist group as well as the sociology of joining terrorist groups. Once the group is formed, we look at what predicts its trajectory over time.

We especially are interested in why groups disappear, as many of them do, the sorts of things that can lead to the rapid end of a group. Finally, we look at also social and psychological impacts of terrorism, things like resilience, even mundane things like the best way to evacuate an area or a region or a city if there is some high consequence event.

Just to give you some idea, and I'll get back to this, in terms of the complexity, we basically have about 60 researchers mostly in centers around the country. Some of these centers we have very strong connections with, others we may have very weak affiliations. It may be someone who is getting $10,000 in summer salary maybe as a graduate student connected to us.

I have listed -- this continues to evolve, but we have got about 25 university partners. Most of them are in other places in the United States. Some of them are in Europe and Israel. We are doing right now about 30 different projects, 12 for this first terrorist group formation and recruitment, about nine projects on terrorist group persistence and dynamics, and about ten on social and psychological impacts. I am giving you this information to

give you an on the ground view of how these problems are affecting us.

I will list the projects. This is group one. We have got things looking at everything from recruitment of terrorists in prisons, the role of the media in reducing terrorism, distinctive characteristics of terrorist groups, and so on and so forth as group one. Group two, everything from social networks, patterns of radicalization, sudden desistance, modeling risks of future terrorist attacks. Group three, we are doing a large national household survey on preparedness, looking at mental health consequences of resilience and so on. Some of these projects can be $25,000 as our total commitment, others are a bit larger. In some ways we resemble a kind of -- like 30 small National Science Foundation grants with an administrative head.

What kind of challenges does this environment raise for us, the sensitive but unclassified environment? I have come up with five from the ground, in terms of trying to respond to these issues that I have found particularly difficult. Many of these have been mentioned in a very interesting way by earlier speakers today.

First and in some ways the most obvious is the impact on national collaboration. This has at least two parts. One is more familiar to us and it has been stated several times. It goes back to the fact that the United States has been a leading -- has an incredibly important role in terms of educating people around the world. At my last count, we had something like 260,000 foreign students enrolled in U.S. graduate programs. I think no one missed the idea that these numbers declined a bit after 9/11 and so on.

In terms our own specific case, about 20 percent of our collaborative research projects involve researchers from other countries, including our research director right now. Likewise, about 25 percent of our graduate students that are working on START projects, we've got 82 of them at last count, are foreign nationals. There is a bit of an irony here in fact, because we were strongly encouraged by DHS when we were doing this grant application to involve as many non-U.S. participants as we could, which if you stop and think about it for a minute makes great sense when you are studying global terrorism, because obviously a lot of what is going on is happening outside of

our shores. So I think that is an obvious issue.

One that is a little bit less obvious, although Dr. Marburger referred to it earlier, is this whole business of what is the underlying connection between nationality, terrorism and security. One of the databases that we have been looking at and have developed in our center, which I think is the most extensive of the open source databases on terrorism that now exist, shows that national terrorism outnumbers international terrorism at a rate of about seven to one. In other words, it is much more likely for us to be attacked by one of our own national citizens than by a foreign national. If you think about it, apart from 9/11, the most destructive terrorist attack in modern U.S. history was conducted by Timothy McVeigh and associates, an American citizen with a long military record.

Likewise, when you talk to our colleagues in Europe right now, the last two very high profile events in London and Madrid, as well as a number of events that did not get as much press attention where there was a successful thwarting of the effort, involved European citizens, mostly second generation European citizens. So I

think we really have to look at this issue in an empirical sense too, about to what extent is this international embargo going to in fact make us safer.

Secondly, scientific limitations of closed analysis systems. I know I am speaking to the choir on this one, so I am not going to go into great detail. The more information we place in the SBU box, the greater the limitations to open scientific investigation.

But let me just give you one specific example of this from our center, one that I have worked on. One of the things that we are doing is collecting large open source databases on terrorist events. The one that we are doing is called the global terrorism database. It stretches now from 1970 to 1997. Our goal is to eventually push these data out in real time. We have got a laboratory in Monterey working on it right now.

I mention this, because right now a totally open process in a university has by far the largest of these open source databases that exist. When I started working in this area, I thought somewhere in the bowels of the CIA or DHS or somewhere else there would be these other fantastic open source databases. Increasingly I don't

think that is the case.

We are working on a project right now with RAND, for example. RAND is the world leaders in terms of designing these databases. Ours is something like seven times larger than the RAND database. So it is sometimes the case that you can get richer, better, more valid data in an open environment.

I think there are three scientific advantages of this openness. We can first draw on the best talent from anywhere in the university or increasingly, around the world. We do not face the same political pressures that governments face in terms of defining highly charged political behavior such as terrorism. This has thwarted the United Nations. Still to this day there is no universally accepted definition of terrorism for this reason. Third, when we get it wrong, we have plenty of people out there who are willing to tell us. We are going to make these data available to the research community, and I'm sure if we don't classify a particular event the way it should be, we are going to hear about it very rapidly.

So ironically, we are in a situation where everybody wants our data. The national labs want our data,

the CIA wants our data, DHS wants our data, and it is open source data developed in the university environment.

Third I would say are disadvantages of applying a physical science model to the social sciences. A national policy on sensitive but unclassified is going to likely be based more on physical science than on social science, for the very obvious reason that social sciences leave a relatively small imprint in the DoD world, in the intelligence world in general.

But many of the security issues raised by the physical sciences are very different from the issues raised by the social and behavioral sciences. For example, most of our research in our center involves either studying the behavior of terrorists and terrorist groups or studying citizen responses to terrorism.

As one of our advisory board members recently told me, Tom Ridge, former director of DHS, he said that telling terrorists about their own behavior is not likely to have huge security implications because presumably they already know about their own behavior. We can of course debate this. It is not a cut and dried issue, and I shouldn't present it that way, but my guess is, many of the

projects we are doing, if there were some sort of a classification system involving sensitive but unclassified material, they would eventually be found to be exempt. But the internal costs of applying this method for and receiving such an exemption can be extremely high.

The best analogy I can think of in the social and behavioral sciences is in the area of institutional review boards or human subjects research. All of you know, to do any research on human subjects in universities in the United States, it is necessary to get the approval of an institutional review board.

This has been a huge, huge issue for our center. I listed the 30 projects we have involving human subjects, most of them at other universities, many of which we have got a sub-subcontract relationship with. We did eventually get all 30 of our research projects cleared in terms of IRB approval, but it was a costly design.

As many of the earlier speakers have said, we have to take a cost-benefit approach to this. Yes, perhaps this is a necessary thing, but it doesn't come without a cost. The decisions are often made by non-subject matter experts. Often we are slowed down in the launch of a

research project. Sometimes we want to be out in the field immediately. We want to be investigating what happened in the Madrid bombing and what happened in the London bombing. So it makes rapid response research very difficult.

It also is a difficult cross-institutional problem, because a lot of times, what is happening with our subcontracts is that each university in the subcontracting chain wants to impose IRB restrictions, and they are all somewhat different in terms of how they implement it. So there is real cost.

I just brought one humorous real world example. It involved a project that started in the University of New Mexico to interview inmates. Its budgeted entire amount was $25,000, including indirect costs. This tells you the exact process we have been going through to get this thing approved, and it still ain't over.

I listed separately the actions we took, the actions of the investigator in blue, the actions of the Maryland IRB committee in red and so on. My point is simply -- this is a worst-case scenario, but my point is, these sorts of heavily bureaucratic implementation decisions do not come for free. My guess is, we spent more

than $25,000 in staff time already.

I point this out because the committee I think is likely to be very much influenced by the physical sciences in coming up with a model, but it could be that a one size fits all approach may not be the best way to go. The IRB approach came from medical schools, but we are now having to play the same kinds of methods when we are interviewing people as opposed to performing surgery on them. So another potential issue.

Then finally, another issue, ineffectiveness of top-down bureaucratic solutions. John Marburger's presentation brought up the cost-benefit analysis, which I thought was very interesting.

I don't want to say too much about this, because again I am speaking to the choir. One of the things that struck me about picking up the pieces of 9/11 is that one of the real success stories of 9/11 was the civilian response, when you think about it. I understand that there were no civilian casualties below where the airplanes hit the World Trade Center, except for first responders who had ineffective communications in terms of responding to the crisis. But the civilians did pretty

darn well getting themselves out. Even ones with injuries and so on helped each other out. Likewise, the only successful counterterrorist strike in 9/11 involved a group of civilians that took over an aircraft five or ten minutes before the government was aware that it had been hijacked.

So in terms of coming up with a solution, I think we really need to be careful that we empower the people on the ground, the people in the weeds, to be making important ethical decisions that would increase the security of us all.

I have been struck already by the work of our center. We have a group of geographers for example who have been doing work on location of sensitive infrastructure. On their own, before they had any DHS funding, they had come up with a way of scrambling, using a special computer program to scramble information so that it would not be made publicly available to people that would be interested in doing us harm. So I think we want to be careful to construct a policy that doesn't turn off the very important resilience of these thousands of scientists we have working in labs, working in universities out there.

Just to conclude this part, implementation.

You can imagine, given the view of the structure of our organization, the implementation problems I am going to have, when I have got 50 researchers at 30 different universities working on research for us, in some cases with relatively small investments. I'm not saying it can't be done, but it is going to be a pretty costly arrangement.

Do I have one more second? I thought the group would also be interested in how we are trying to resolve this issue, because we have projects running. These issues are coming up in real time for us.

We have taken the homeland security policy and tried to translate it into at least a temporary plan. We have been already trying to identify sensitive but unclassified information. This is very much a work in progress.

This is a summary of the DHS policy put into PowerPoint slides. Its research result, which will be freely disseminated except when the research involves economic risk or risk analysis models where it could expose developing or current technology, the release of which could hinder national security and so on. Again, this is taken straight out of Homeland Security.

We are setting up a procedure to try to identify these cases, and it will be triggered with terrorist organizations could not independently and for the same information developed under a research project from open sources under reasonable conditions, or that information provides specific guidance on how to effectively execute a terrorist attack.

Here is our draft response. We are trying to put in place a temporary solution to this problem. First, at the pre-award stage, which is much easier, because if you have a foreign graduate student for example, obviously you want to let them know that this is probably not a good project for them before the project begins. So we have set up a process to do this involving the university in partnership with Homeland Security. Then we have also done a draft policy where the project is already underway and someone, either the researcher or someone at Homeland Security or the administration of the project at the university says, this looks like a sensitive but unclassified issue, and perhaps we better take it more seriously.

So we are in the situation that a couple of

earlier speakers alluded to, where we have had to do something. We are putting together a temporary policy, but we certainly could use more guidance from the policy community.

I will leave it at that. Thank you very much.

MR. HART: Thank you, Professor LaFree. We will now break for 22 minutes, resume at 3:30, welcome you all back then.

(Brief recess.)

MR. HART: It has been pointed out to me by the conference secretary that I have committed a mortal sin by having a coffee break, which was not on the final schedule. So I apologize to all concerned.

I want to give panelists about two minutes to ask each other questions or comment on the others' presentations, if they wish, at this time.

DR. LaFREE: I would like to ask the other panelists to talk about how their universities or institutions have been handling at all the sensitive but unclassified issues.

DR. MONIZ: That would be an excellent question for Alice Gast to address. She is our principal handler.

DR. GAST: We don't, in the sense that we will not accept any contracts or grants that have any restrictions on them. So we haven't really had to address this issue that you are with the homeland security center.

I did want to ask you a little bit about that. We can wait a minute until we get to the public part of the discussion. But I think one concern I have is this concept that you can start with perfectly open sources of information and perfectly open work, and put the pieces together and then all of a suddenly magically different happens, and that becomes sensitive but unclassified, and now you have a problem.

While we have long had any of our research could become classified, and we know how to deal with that, we deal with it when we have to, having it become sensitive puts you in a situation that could look a bit like jeopardy, where you can't really restrict it because then you are putting restrictions on your own work, where you set yourself up for issues regarding export control and other restrictions. On the other hand you can't really ignore it if you so deemed it.

So I am interested in how you are really going

to handle that, taking things that are perfectly open, putting them together and having them become sensitive.

MR. HART: Any other questions, observations? Let's ask the committee if -- sorry.

DR. LESTER: This is not directly to Gary's question, but the question did come up during the interval, and I feel obligated to observe -- probably I should have done it when I spoke -- that those applicants that I mentioned to the Department of Nuclear Science and Engineering from Yemen and Venezuela were not admitted.

DR. BAKER: One of the things that our institution has done, we do not have Lincoln Labs, so we cannot parse based on an entity. I think this has become an issue of conflict between different universities that we probably don't want to debate here, but you are going to anyway.

I think that one of the things that we have done is force people who have been told that have restrictions, we press back on them, and uniformly they have caved. In fact, we have had bigger problems with private foundations and private entities seeking restrictions on publication and other things than we have

from the government.

DR. GAST: So I should set the record straight on a couple of fronts. We do not send research from MIT over to Lincoln just because it has become classified or sensitive. Lincoln Labs is an FFRDC with an Air Force contract. It does work for the Air Force and it fits under that contract, and we can't just throw things over the transom into their pot.

We do collaborate with Lincoln. We are very fortunate to have that interaction and to be able to serve the nation in that way, but it is not something that alleviates this problem.

MIT has over the years, long before I get here, and in the past few years pushed back very hard on these issues, to the extent of turning back contracts that we could not ultimately negotiate, and negotiating contracts that took months up to a year to negotiate to get the language right. So I do think it is important that we remain unified in that approach, and work on it as a community.

I do agree that the industrial contracts are very important, and we take it very seriously not to accept

any additional restrictions from industry than we would from the government. So we will not let industry have an approval clause over our research contracts, just as we would not let the federal government. I believe it is very important to be vigilant on that.

I was concerned that Dr. Marburger mentioned that in his remarks, implying that universities would accept more restrictions from a university than they would from the government. At least that is not the case at MIT.

DR. MONIZ: If I may add one other comment, which is not directly relevant, but nevertheless might be of some interest along these lines, the issue of labs attached to universities, and particularly DUE systems.

When I was at DUE, this was pre-9/11, we had some difficulties involving security and issues of this type. We welcomed a counterterrorist expert into our bosom. But a very important issue for the DUE labs was that part of the, what I would call problem we solved by offering the opportunity for laboratories to have neither classified research nor classified materials on the premises. That got those laboratories, Slack was one of them, but in other cases there were some issues. Well, to

be honest, Slack was a problem, because Slack had classified materials on the site, and the deal was, those go. Then most of the counterterrorism inspired suggestions they were exempted from. But it really required having an absolute wall.

So just to clarify, members of the staff could individually hold clearances and do classified work, but they could not bring any materials onto that site.

DR. GANSLER: First I wanted to make sure, Gary, you answered Alice's question, the question of, if you start off with unclassified and shifted.

Ernie, I was interested in your viewpoint. Some of the things that you emphasized as important in terms of future energy, and Jim did too in his talk, are on the export control list, batteries, fuel cells, things of that sort. It seems to me that you are going to start to get hit with this deemed export control directly, not just you, but obviously a number of other universities. I would be interested in where you stand and what you plan on doing on that.

Then, Professor Baker, it seems to me that nano bio stuff which you describe, which is 100 percent dual

use, is right in the middle of this controversy. I am wondering if any of the issues of sensitive but unclassified and so forth, how Michigan is going to deal with those. So those are my questions.

DR. MONIZ: I would defer most of that question to Alice Gast, since I don't have the responsibility for -- I have the responsibility to create the problem, not to resolve it.

But you are absolutely right. For example, in our initiative we intend to significantly increase our program in storage, energy storage, advanced batteries, et cetera, where in my view there is absolutely no security issue linked with the research per se in this scale.

The irony is, if you go to the last part of my talk, it may be much more sensitive at those very small scales that I was talking about, where this intersection with the intelligence requirements becomes more interesting.

But I would note as well, before turning it over to my colleague here, Mr. Baker, that we will have the same thing. For example, one of the areas where are ramping up will be a focused effort on one part of the biofuels issue,

bringing together essentially genomics and metabolic engineering. Jerry Fink is part of that, who chaired the Academy committee on this issue.

So you are right, these issues are going to be there, and we rely upon Alice to --

DR. GANSLER: A lot of your students working in this are foreign students.

DR. MONIZ: Absolutely. I might add, not to mention the faculty.

DR. BIENENSTOCK: But the fundamental research is excluded so far, and you just have to face it grant by grant.

DR. MONIZ: Yes.

DR. BAKER: To be cynical, you could say that we will just wait until they have better stuff than we do, and then the export restriction will be off.

What we have seen is that it is so hard to define applications in these areas, either for collection, how do you identify people who are doing things that are unreasonable versus mainstream. The material itself is inert, it doesn't have any function. So most of it can be bought from Sigma Aldridge. There are companies that are

making this material literally around the world, so there is really no restriction for this work.

As I alluded to this morning, what we really want to do is make sure that our researchers are involved in the world community that is doing this work, so we are aware of these things, and not acting as spies, but as reasonable people pointing out when something is not appropriate.

My concern about what is going on now is, they are taking the nuclear model to this, where they can control it, put it at Livermore, lock it up and keep the people there and be safe. It is not what we are teaching them, it is what is already out there, and we need to be involved in that. It is a totally different model in terms of security.

DR. LaFREE: May I add one more footnote, spurred by Artie's comment. I agree that up to now, certainly the basic research exclusion seems to hold, but I would just note in a way that is not yet fully defined, at least in the energy initiative that we are talking about here, building upon the institute's history in terms of innovation and moving technologies into the marketplace, we

are talking about potentially going to an area that will include direct collaboration with industry in terms of pilot scale facilities when appropriate.

There it becomes an issue where it might start becoming more gray, and some of these issues may come into play. Indeed, this biofuels approach that I mentioned would be a candidate very clearly. If the basic research worked out, you could easily see going to a pilot scale, semi-institute, semi-industry new frontier.

DR. MESERVE: I have a question in a related area for Richard and for Ernie. As both of them know, the Department of Energy has announced a major initiative for recycling, taking spent fuel and reprocessing it and fast reactors and the like. That program should have a major research component to it. That research component, some of it might appropriately be done at universities, and would no doubt involve having researchers involved in actonite chemistry and processing technologies.

Many of your students are foreigners, and it is plausible to believe that they would learn things in doing that work that would be directly relevant to a nuclear weapons program. The question for you is, how do you think

as a matter of national policy we should handle that problem?

DR. LESTER: I'll start. I really don't have a good answer to the question. I agree with everything in the way of the presumptions in the question.

It should be said that the other half of this, which I know, Dick, you are very well aware of, is that the Administration in parallel with its initiative in this area of actonite recycling and actonite related technology has also proposed -- and I think I alluded to this briefly -- that there be a distinction drawn in the execution of the fuel cycle policy between country states that have nuclear fuel cycle facilities and those that don't. As a mechanism for maintaining that distinction, the proposal as part of the policy envisages the fuel cycle countries offering the non-fuel cycle countries services, fuel cycle services, if they agree not to make their own investments in these technologies, or even more generally in enrichment and reprocessing technologies.

But this really creates a number of serious difficulties for us, or at least, I think it will potentially create serious difficulties. In effect, for

example, hen it comes to admitting students, when it comes to allocating research assistantships, it puts us in the situation where in effect we have to try to decide which group of countries the student belongs to, and that seems to be something of a moving target.

In fact, we had a visit from one of the leading Administration spokesmen on this initiative just a week or so ago, who discussed a third category of countries that were neither exactly fuel cycle haves nor fuel cycle have-nots, but they were countries that we might wish to collaborate with, the U.S. might wish to collaborate with on these new actonite related technologies, even though we wouldn't necessarily wish to see them practicing these technologies on a commercial scale.

The issues that this raises for us and for other universities I think are likely to be quite difficult. I don't have an answer, and maybe Ernie does have an answer, but I think you are absolutely right to point to this as a potential problem.

DR. MONIZ: It is a hard question, I agree with Richard on that. By the way, I might just add, to add a little flavor to it in terms of our own discussions

particularly with Idaho and other universities as well, we have had now two workshops here to look at how our research for example here might fit into this broader program. We have had a lot of discussion particularly on new levels of tools for advanced fuel cycle simulation, a desperately needed capability. But once you get into that and all the issues you are talking about, it may not be in the laboratory as such, but you have to have access to a lot of data and all kinds of issues.

So A, it is a problem, B, how do you approach it. I start out with my base position, if the student has been admitted to the United States by the State Department and the student can study whatever the hell the student wants to study that we offer as options. The student may want to choose where he or she wants to focus the research, given their own ideas about their future career development, but nevertheless I think that principle is the one that has to stand.

That can get us into awkward situations of the type Richard was alluding to, but in a fairy tale world in which the government, our government in particular, in collaboration with other advanced countries and other

developing countries puts in place something like the fuel leasing concept that Richard alluded to, then I think the problems are manageable at the university. The problem is without the structure, because in that structure you would offer the kinds of incentives and on the ground incentives for countries to have this partnership arrangement to just have reactors, and in doing so they would also have satisfied things like IAEA additional protocols, et cetera.

So the problem then goes to the IAEA and the country. The issue is then not doing enrichment, not doing recycling in those countries. The trouble is, in the world that we are in, it is extremely difficult to know how to handle this problem.

DR. LaFREE: Could I respond to Alice's earlier question? Alice's question is, you start with unclassified or unsensitive but unclassified data and have it turn into that. We have three things going on right now, one with the National Labs, one with the FBI, and one with the Department of Defense, where they are using our open data, but they have made it sensitive but unclassified because they are using it. But in those cases, we have maintained the idea that for our own use, it is not like they are

taking our data over and then making it classified. So that has been a pretty clear line.

I should emphasize that we see this process as not affecting a huge proportion of our projects. But let me just give you one worst-case scenario. The first of these centers of excellence created is the Create Center, headquartered at USC, mostly economists and engineers. They do quite a few simulations. They did a simulation involving the placement of dirty bombs, where they studied the plume and the fatalities, where they looked at whether it was more effective to have the bomb at ground level, on a bridge, dropped from an airplane and so on, and basically calculated the most effective way to place a dirty bomb. For obvious reasons they didn't want this stuff going on the Internet, but it all came from open source information.

So there are those sorts of projects, even with open source data.

MR. HART: The world of science and high technology has fallen into the hands of the local taxi service, so Professor Bienenstock will ask the last question, a very precise question, and the panelists will give very precise answers.

DR. BIENENSTOCK: I was surprised by Richard Lester's response to the actonite chemistry question. I thought that MIT had policies that forbade accepting contracts that limited people who could work on them by country of origin. Therefore, you should never have to face that problem for national policy.

Presumably there are program officers deciding which contracts can be let to universities in the absence of any restrictions on who can participate, and which go to the National Labs. When I used to have to try to justify the existence of National Labs, the very first thing that came to mind was actonite chemistry, besides large facilities. It is a very important function of the National Labs.

But I wanted to take issue with Alice on one thing. that is, Alice said all of us universities should band together on sticking against restrictions of this sort. If you look nationally, there is a wide range of actions of universities on proprietary research and in classified research. Some will do it, some won't. It really serves the nation very, very well that we have this wide range of universities. It helps local industries in

certain areas and things of this sort. I would not seek one common stand on this, but would urge that we maintain the diversity of the institutions in this regard.

So I guess that wasn't a question.

MR. HART: Responses?

DR. MONIZ: I'd just note, what makes you think the laboratories have actonite chemists?

DR. GAST: Artie, I would agree with you that the universities and the diversity of approaches could be healthy for the nation. I can see this among our own colleagues; as research is pushed into areas that are more on the edge of applications, you do start to fall under restrictions. There is a lot of pressure to accept that kind of money, whether the university is fully aware of what it is starting and able to comply fully.

I think if a university did decide to go that way and do work that requires restrictions or requires segregation, et cetera, they had better be really aware and ready to be able to comply with all the restrictions and regulations, because if they are not able to, we will all be harmed, and there will be concerns about what goes on everywhere.

MR. HART: I hope you will all join me in thanking this panel for very excellent presentations. We are adjourned until tomorrow morning.

(The meeting was recessed at 3:55 p.m., to reconvene Tuesday, May 16, 2006 at 8:45 a.m.)