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SCIENTIFIC AND TECHNICAL ADVICE
FOR THE U.S. CONGRESS

HEARING
BEFORE THE
COMMITTEE ON SCIENCE
HOUSE OF REPRESENTATIVES
ONE HUNDRED NINTH CONGRESS
SECOND SESSION

JULY 25, 2006

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SCIENTIFIC AND TECHNICAL ADVICE FOR THE U.S. CONGRESS

TUESDAY, JULY 25, 2006

House of Representatives,
Committee on Science,
Washington, DC.

The Committee met, pursuant to call, at 10:09 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Sherwood L. Boehlert [Chairman of the Committee] presiding.

<GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT>

hearing charter

COMMITTEE ON SCIENCE

U.S. HOUSE OF REPRESENTATIVES

Science and Technology Advice

for the U.S. Congress

tuesday, july 25, 2006

10:00 a.m.-12:00 p.m.

2318 rayburn house office building

1. Purpose

On Tuesday, July 25, 2006, the Committee on Science of the U.S. House of Representatives will hold a hearing to examine how Congress receives advice about science, and whether and how the mechanisms for providing that advice need to be improved.

2. Witnesses

Panel 1:

The Honorable Rush Holt is the Representative from the 12th District of New Jersey.

Panel 2:

Dr. Jon Peha is a Professor in the Department of Engineering and Public Policy and Electrical and Computer Engineering at Carnegie Mellon University. He also was the co-editor with M. Granger Morgan of Science and Technology Advice for Congress, a compilation of policy papers evaluating existing systems and providing recommendations for science and technology advice for the legislative branch.

Dr. Al Teich is the Director of Science and Policy Programs at the American Association for the Advancement of Science (AAAS). He is also the author of Technology and the Future, a collection of papers on how technology and society interact.

Dr. Peter Blair is the Executive Director of the Division on Engineering and Physical Sciences at the National Academy of Sciences. He previously served as Assistant Director of the Office of Technology Assessment.

Dr. Catherine Hunt is the President-elect of the American Chemical Society and the Leader for Technology Partnerships (Emerging Technologies) at the Rohm and Haas Company. She is a member of the Executive Board of the Council for Chemical Research.

3. Overarching Questions

The hearing will address the following overarching questions:

1. What resources are available to Congress to provide scientific and technical advice or assessments? How does Congress use these resources?
2. What are the strengths and weaknesses of the current system through which Congress receives scientific and technical advice? Overall, does the current system effectively meet Congress' needs, or do gaps exist?
3. What options are available to supplement or improve existing resources to provide advice and assessments on scientific or technical issues?

4. Brief Overview

<bullet> Congress currently receives information and advice on science and technology issues from, among others, the National Academy of Sciences (NAS) and the Congressional Research Service (CRS), science and engineering professional societies, interest groups and think tanks. Additionally, some Congressional offices employ staff with scientific backgrounds.

<bullet> From 1972 to 1995, the Office of Technology Assessment (OTA), a Congressional support office, prepared reports at Congressional request on science and technology

issues. In 1995, funding for OTA was eliminated.

<bullet> Reports from scientific groups and experts released in recent years have criticized the lack of a dedicated source of scientific and technical advice and assessment for Congress. They argue that the resources currently available do not always provide Congress with in-depth analysis, including analysis of multiple policy options, in a form and on a schedule that is useful to legislators.

<bullet> Congressional advocates of creating (or recreating) a Congressional entity for science advice responded to this criticism, in part, by creating a pilot project within the General Accounting Office (GAO) to provide advice on specific issues. The Legislative Branch appropriation in fiscal years 2002-2004. GAO has completed four assessments as a result--one each on biometrics, cyber security, wildland fires and cargo security.

<bullet> Advocates of an expanded scientific and technical assessment capability to support the Legislative Branch have proposed several options, including: (1) augmenting the capabilities of existing Congressional agencies, (2) expanding the use of the National Academy of Sciences, (3) increasing the number of privately-sponsored Congressional science and engineering fellows, (4) establishing a small Congressional office that would farm Members' requests for information out to expert non-governmental organizations, or (5) chartering a non-governmental organization dedicated to providing science advice and technology assessment for Congress.

5. Background

History of the Office of Technology Assessment

Congress created the Office of Technology Assessment (OTA) in 1972 to aid Congress "in the identification and consideration of existing and probable impacts of technological application." \1\ All technology assessments conducted by the office were approved by the Technology Assessment Board, a bipartisan body made up of six Senators and six Representatives. Assessments could be requested by a committee chair, the ranking minority member of a committee, the majority of members in a committee, the Technology Assessment Board, or the director of OTA.

\1\ OTA was created by the Technology Assessment Act of 1972 (P.L. 92-484).

Funding for OTA was eliminated in 1995 as part of an effort to reduce size of the federal budget and the Congressional budget and bureaucracy. Proponents of eliminating OTA also argued that OTA reports took over a year to complete (as do many National Academy reports) and, therefore, were not available to legislators in a timeframe that was useful to them, and that Congress would be able to obtain similar advice from NAS, CRS, and GAO. Also, some Members felt that some of the reports produced by OTA were not pertinent to the legislative agenda or reflected a political bias.

GAO pilot program in technology assessments

The Fiscal Year 2002 (FY 2002) Legislative Branch Appropriations Conference Report allocated \$500,000 to GAO to conduct a study as part of a pilot project in technology assessment. The resulting report, released in November 2002, was entitled Using Biometrics for Border Security.\2\ FY 2003 and FY 2004 appropriations reports contained similar allocations, and GAO completed another technology assessment in May 2004--Cyber Security for Critical Infrastructure Protection.\3\ GAO completed the pilot project with two other technology assessments--Protecting Structures and Improving Communications During Wildland Fires, released in 2005, and Securing the Transport of Cargo Containers, released in 2006.

\2\ Using Biometrics for Border Security, Report GAO-03-174, is available on-line at <http://www.gao.gov/new.items/d03174.pdf>.

\3\ Cyber Security for Critical Infrastructure Protection, Report GAO-04-321, is available on-line at <http://www.gao.gov/new.items/d04321.pdf>.

In addition to providing funds for these pilot technology assessments, Congress requested two reviews of the pilot project's performance. Overall, the external review, completed in 2002, reflected very favorably on GAO's performance. The reviewers found that GAO did a ``very good job'' given the constraints--a very short timescale for the assessment and no previous experience with conducting technology assessments. However, the reviewers also noted that GAO has few staff with adequate knowledge and experience of broad scientific and technical issues necessary to evaluate a range of policy options.

6. Proposals for Improving Science Advice to Congress

Over the past several years, numerous proposals have been offered for improving Congress' access to science advice and technology assessment through legislation and policy recommendations. Bills to directly re-establish the Office of Technology Assessment were introduced in the 107th and 108th Congresses. Additionally, legislation to create new Congressional agencies responsible for providing non-partisan scientific and technical advice has been introduced. In June 2004, Congressman Holt introduced H.R. 4670, which would build upon the pilot project at GAO by establishing within GAO a Center for Scientific and Technical Assessment. (That bill has not been re-introduced.) The Center would be dedicated to providing Congress with information, analysis, and advice on issues related to science and technology. In the Senate, Senator John Kerry introduced S. 1716 in 2001, in which Section 153 created a Science and Technology Assessment Service to provide ongoing independent science and technology advice ``. . . within . . . the legislative branch.'' Assessments would have been conducted using experts selected in consultation with the National Academy of Sciences.

Science and Technology Advice for Congress, a collection of essays by various authors, analyzes a number of potential means for expanding the scientific and technical assessment capability for the Legislative Branch. In addition to legislating mandating the creation of a dedicated Congressional support office in this area, authors representing groups such as AAAS, NAS, and various universities suggest improving the access to and responsiveness of private organizations capable of providing expert advice. One recommendation is to establish a cadre of private organizations who are prepared to quickly respond to

questions distributed by a central office in Congress with knowledge of their areas of expertise. Another suggestion involves expanding the role of privately-sponsored Congressional science fellows by increasing the number of fellows available for employment in Congressional offices and better preparing them to deal with policy issues that arise in these positions. The editors, Morgan and Peha, note that ``any analysis process must continuously work to build widespread support among members on a bipartisan, bicameral basis, so that when conflicts arise. . .support for the analysis institution remains firm.''

\4\ Morgan and Peha, 103.

7. Questions for the Witnesses

<bullet> What resources are available to Congress to provide scientific and technical advice or assessments? How does Congress use these resources?

<bullet> What are the strengths and weaknesses of the current system through which Congress receives scientific and technical advice, particularly with regard to depth and breadth, timeliness, and impartiality? Overall, does the current system effectively meet Congress' needs, or does a significant gap exist?

<bullet> What options are available to supplement or improve existing resources to provide assessments and advice on scientific or technical issues?

Chairman Boehlert. Good morning. I want to welcome everyone here to--for today's hearing on the vitally important topic of how Congress should get scientific advice. I want to thank Dr. Holt for urging us to have this hearing.

We have an excellent panel of witnesses before us today, and I hope they will give us some specific ideas for how we might improve the mechanisms for providing science advice to the Congress. I think we need to get beyond the debate about reviving the Office of Technology Assessment.

I must add I am a very strong defender of OTA, and I voted against defunding it, but the others didn't see the wisdom of the path that Dr. Holt and Dr. Ehlers and Dr. Bartlett and all our distinguished scientists were leading us down. Unfortunately, we didn't prevail. But OTA is not likely to be coming back any time soon.

I also have to say, as a proponent of OTA, that the reaction to the loss of OTA has been somewhat disproportionate. If you listen to the scientific community, you might think that OTA was the only thing separating Congress from barbarianism. We do have plenty of current sources of information, particularly the National Academies, and boy, do they do wonderful work. So the question before us today is: what specific gaps exist, and how can they be filled?

Also, much of the lament one hears about OTA's demise is really not a concern about what advice Congress is getting, but rather, about what decisions Congress is making when it gets that advice. So, it is important to remember that not all people will reach the same policy conclusions based on the same

scientific information, even if they understand and accept that information.

Perhaps the most dangerous fallacy in Washington is: ``If you knew what I know, you would think like I think.' ' Let us not confuse policy differences with ignorance.

Which is not to say that Congress does not sometimes display ignorance, sometimes willful ignorance. But that is not a problem of not receiving advice, it is a problem of not listening to it. To take one current example, a high profile example, I might add, the National Academy, a few weeks ago, released a clear, balanced, and thoughtful overview of the current understanding of global temperature over the past 1,000 years. Some Members have taken that report to heart. Others are trying to distract from its conclusions by focusing on individual papers that have already been superseded. That is their right, but my only point here is that debate says nothing about the quality of information Congress is receiving.

I like to tell people that I work in an institution, and in a town, where everybody likes to say they are for science-based decision-making, but when the overwhelming scientific consensus leads to a politically inconvenient conclusion, then they want to go to Plan B.

Well, I look forward to hearing from our witnesses today, but in discussing what kinds of information science needs, let us make sure we are not confusing the availability of information with any other issues.

With that, I am pleased to turn to Mr. Gordon.

[The prepared statement of Chairman Boehlert follows:]

Prepared Statement of Chairman Sherwood L. Boehlert

I want to welcome everyone here for today's hearing on the vitally important topic of how Congress should get scientific advice, and I want to thank Mr. Holt for urging us to have this hearing.

We have an excellent panel of witnesses before us today, and I hope they will give us some specific ideas for how we might improve the mechanisms for providing science advice to the Congress. I think we need to get beyond the debate about reviving the Office of Technology Assessment (OTA).

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Also, much of the lament one hears about OTA's demise is really not a concern about what advice Congress is getting, but rather about what decisions Congress is making. So it's important to remember that not all people will reach the same policy conclusion based on the same scientific information--even if they understand and accept that information.

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So I look forward to hearing from our witnesses today. But in discussing what kinds of information science needs, let's make sure we're not confusing the availability of information with any other issues.

Mr. Gordon.

Mr. Gordon. Thank you, Mr. Chairman, and thank you for scheduling a hearing on this important topic of science and technology advice to the Committee, and we are particularly pleased that Congressman Dr. Holt is among our witnesses, and thank you for being here, Rush. You lend a particular dual role to this hearing.

We appreciate your leadership on this topic, and are pleased to join you in seeking better ways to incorporate the best available scientific and engineering knowledge to our legislative activities.

It was over 40 years ago that the Science Committee first addressed the topic of science advice to Congress. Congressman Mim Daddario, a Member of the Committee, a charter Member of this committee, and Republican Chuck Mosher co-authored the legislation that created the Office of Technical Assessment.

It was Charles Lindbergh who got Congressman Daddario focused on technology assessment. In the early 1960s, Lindbergh was concerned that the Earth was heading for disaster, unless the balance between science and ecology were properly adjusted. Does my friend from California, Mr. Rohrabacher, think that this sounds familiar?

Mr. Rohrabacher. Well, I certainly do respect Mr. Lindbergh.

Mr. Gordon. Lindbergh felt Congress needed specialized scientific expertise to analyze this and other tough problems. Daddario and Lindbergh continued to talk about technology assessment for several years. During the 1960s, the Committee had many hearings, and issued several reports on science advice to the Congress that paved the way for legislation creating OTA in the early 1970s.

In the early '70s, the legislation that established OTA was reported unanimously by the Committee on Science. The Committee leadership then worked bipartisanly to get the bill through the House and Senate.

During its twenty years of operation, OTA created 700 reports on the science and technology behind issues of importance to Congress.

We could use a service like OTA today, since relatively few Members of Congress have formal training and experience as scientists and engineers, and since much of the information we receive comes from advocates selling their points of view.

In the years since OTA, we have had an increasingly difficult time of reaching consensus on a wide variety of these topics. We certainly could use in-house help in sorting through conflicting expert opinion.

I therefore look forward to the testimony of today's experts, and to taking the first steps toward improving the way in which Congress receives and uses scientific and technical advice.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Gordon follows:]

Prepared Statement of Representative Bart Gordon

Mr. Chairman, thank you for scheduling a hearing on the important topic of science and technology advice to the Committee and for including Congressman Holt among the witnesses.

We appreciate your leadership on this topic and are pleased to join you in seeking better ways to incorporate the best available scientific and engineering knowledge into our legislative activities.

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In the years since OTA, we have had an increasingly difficult time of reaching consensus on a wide variety of these topics. We certainly could use in-house help in sorting through conflicting expert opinion.

I look forward to the testimony of today's experts, and to taking the first steps towards improving the way in which Congress receives and uses scientific and technical advice.

[The prepared statement of Mr. Costello follows:]

Prepared Statement of Representative Jerry F. Costello

Good afternoon. I want to thank the witnesses for appearing before our committee to examine how Congress receives advice about science and discuss how this process can be improved.

For over twenty years, the Office of Technology Assessment (OTA) prepared reports by Congressional request on science and technology issues. In 1995, funding for OTA was eliminated. Currently, Congress receives information and advice on science and technology issues from the National Academy of Sciences (NAS) and the Congressional Research Service (CRS), science and engineering professional organizations, interest groups and think tanks. In recent years, reports from scientific groups have raised concerns over the lack of scientific and technical advice and assessment for Congress.

I am interested to hear from our witnesses what options are available to supplement or improve existing resources to provide advice and assessments on scientific and technical issues given recent concerns. I look forward to hearing from the panel of witnesses.

[The prepared statement of Ms. Johnson follows:]

Prepared Statement of Representative Eddie Bernice Johnson

Thank you, Mr. Chairman and Ranking Member. I would like to welcome today's witnesses and thank you for the perspective you will provide today.

Congress relies on experts from the scientific research community to assess the needs of our national scientific enterprise. It is important to know how America ranks compared with other nations.

Our competitive nature is what makes Americans, with our capitalistic society, one of the richest nations in the world. Americans are leaders.

In order to maintain our cutting edge when it comes to technology matters, we lawmakers need a consistent and reliable source of unbiased advice.

The National Academy of Sciences, the Congressional Research Service, professional societies, and think tanks are all examples of current advisors to Congress.

It is interesting to hear your perspective on whether the way Congress receives its advice needs to be changed or even improved.

Thank you, Mr. Chairman. I yield back the remainder of my time.

[The prepared statement of Ms. Jackson Lee follows:]

Prepared Statement of Representative Sheila Jackson Lee

Mr. Chairman and Members of the Committee, I appreciate the fact that this hearing has been called today in order to re-examine the way in which Congress receives scientific and technological advice.

I would like to thank my colleague Mr. Holt for his interest and commitment to addressing this issue, as well as the other witnesses for testifying today: Dr. Blair, Dr. Peha, Dr. Teich, and Dr. Hunt.

As early as the 1950s, Members of Congress understood the importance not only of scientific and technological advice, but of even-handed ``Technology Assessment Board'' to explore and report on how technological advances would affect the environment. This led to the creation of the Office of Technology Assessment in 1971.

For those who utilized the studies and resources of the OTA, its benefits and value were never in question. Sadly, the agency was cut in 1995 as part of a government-wide belt tightening, and Congress lost its most reliable and balanced science analysis tool.

The Office of Technology Assessment can be compared to the other

three remaining legislative branch research organizations: the Government Accountability Office, the Congressional Budget Office, and the Congressional Research Service. As well respected as these organizations are, none of the three have the infrastructure, staff, or expertise to conduct thorough scientific examinations into legislative proposals or impact analyses on public policy.

Clearly, as we move into the 21st century, we will need increasingly sophisticated resources with which to develop the law of the land, and the public policy of our future. It is crucial that Congress make informed, intelligent, and evidence-based decisions in crafting this nation's energy, technology, and science policy. I hope that the hearing today will be able to further advise and inform us on how to proceed.

Thank you Mr. Chairman, and I yield the balance of my time.

Panel I:

Chairman Boehlert. Thank you very much, and now, we will hear from our first witness, the very distinguished witness, and a colleague with whom it is a pleasure to work, Dr. Rush Holt.

STATEMENT OF HON. RUSH HOLT, A REPRESENTATIVE IN CONGRESS FROM
THE STATE OF NEW JERSEY

Mr. Holt. Thank you, Mr. Chairman, and I thank you and Mr. Gordon for those good remarks.

I know in this committee, you are accustomed to hearing testimony of astounding novelty about really path-breaking advances, but I often tell witnesses, when they are testifying before a Congressional committee, that they shouldn't underestimate the pleasure they give an audience by telling them something they already know. And in this case, I will talk about something that, at least if we are honest with ourselves, we already know, and that is that none of us in Congress either have the time, or in many cases, the ability to analyze scientific and technological advances, make reasoned, logical determinations about their direction and the impact on industry and on nations and on education, on our citizens. And yet, we vote on decisions about topics on a regular basis that include technical and scientific components. The connections to science and technology are not always obvious, especially to Members who avoid science and technology, which, I must say, are most Members. So, if we are honest with ourselves, we have to say we cannot do this alone.

I will be brief, because we have some excellent people speaking after me, and I have read their testimony, I have talked with some of them, and I think we can learn a lot about what maybe we already know. Congress used to have an in-house professional office dedicated to providing technological assessment services. Mr. Gordon referred to Representative Daddario, for example, who helped set this up. And Congress received regular reports, in a legislatively relevant form, on such topics as agricultural technology, alternative fuels, arms control, banking, business and industry, communications, climate change, computer security, defense technology, economic development, education, energy efficiency, fishing, health,

technology, international relations in technology transfer, natural disasters, nuclear energy, nuclear war and weapons, oceanography, oil, gas, mineral resources, transportation, yes, all of those things, on a regular basis.

And Congress decided in 1995 that we didn't need an in-house body dedicated to technological assessment. The technological assessment could come, we told ourselves--this was before my time here--could come through committee hearings, through CRS reports, through experts in our district, through think tanks, through the National Research Council and the National Academies.

Now, you and I know that Members of Congress have a low comfort level with technology in general and are generally unable to probe beyond our personal understanding or the briefing books crafted by our staffers, but let us look at the history. In the ten years since we said that these various groups could provide the technical advice that we need, we have not gotten what we need in order to do the people's work. We should acknowledge that.

Yes, there are organizations that separate us from the barbarians, as the Chairman has said, Congressional Research Service, the National Academies, institutions like Stanford or Carnegie Mellon or Princeton. We have organizations like the AAAS, the American Chemical Society.

We do not suffer from a lack of information here on Capitol Hill, but from a lack of ability to glean the knowledge and to gauge the validity, the credibility, and the usefulness of the large amounts of information and advice that we receive.

And there are real gaps in what Congress gets. We are not getting what we need, I would argue.

But why is this of such importance to Congress? Why do we need a specialized in-house scientific and technical assessment organization or organ? Well, I can think of three what I would call compelling reasons. Science and technology pervade almost all of the issues before us. If you look at today's hearings in the House and the Senate, or yesterday's, or last week's, you will find a number of topics that are being considered that most Members of Congress don't even think of as technological issues, and yet, they have technological components. What we will have on the Floor this week, what we had on the Floor last week, had technological components that in many cases, were not considered fully.

Secondly, the language and technologies are specialized and complex and require translation for Members and their staff. Third, Members think science and technology are for scientists and technologists, thus avoiding science and technology themselves. I think every Member of Congress is aware of the social, economic, moral, and political aspects of the issues before us, and in many cases, Members are good at analyzing those things. Not so with the scientific and technological aspects of the issues before us. Members duck those aspects, flee them, ignore them, or perhaps most often, march off oblivious to them.

The Science Committee is of least concern. Most Members here recognize that the issues that come before you have technological components, and you get the help necessary. However, this may not be true for other committees, all of

which, every one of which, handles topics that have some scientific and technological components, whether it is the Agriculture Committee, the Appropriations Committee, the Education and Workforce Committee, or on down the line.

We need to fill the gaps in our science and technology advice. Technology has been studied extensively by scholars, some of whom we will hear from today, and the lessons are clear. The issues are too complex and the stakes are too high for us to try to wing it on issues like stem cell research or biofuels or technology transfer or healthcare. But if we are honest with ourselves, we should say that we actually don't even need scholars, however good today's witnesses are. We don't need scholars to tell us we need help. If we are honest with ourselves, we know it. We need a dedicated, in-house, permanently staffed organization to give us objective, nonpartisan advice on science and technology issues.

We know it can be done. We have done it before, as a body. I hope we will find a way to do it again, and I thank the Chairman for leading us off on this.

[The prepared statement of Mr. Holt follows:]

Prepared Statement of Representative Rush Holt

Mr. Chairman and Members of the Committee, I thank you for the opportunity to explore the state of science and technology advice and assessment for Congress. You each know my passion for this subject, and I appreciate the opportunity to speak with you on this matter today. I look forward to working with you on this critical topic in the future.

To use a cliché, but to set the stage properly, our world is changing at an accelerated rate brought on by technology. The invention of the transistor in 1947 led to the development of the computer. DARPA, our own military R&D facility, invented the Internet, and in 1989, a scientist at the Center for European Research in Nuclear Physics in Switzerland, invented the World Wide Web to meet the demand for automatic information sharing between scientists working at different locations around the world. Nothing has been the same since these advances; we all depend on our Blackberries and cell phones to keep apprised of the happenings of the world. However, technological advancements extend beyond communications into health care, education, transportation, intelligence and military activities, agriculture, environmental protection, as well as the very process of government from voting to judicial punishments, to agency record keeping. We see the effect of technological advances reverberate around the globe. The gap between industrialized nations and developing nations grows for some. Others nip at our heels to gain the world lead in one technology or another. Human interaction across the globe will never be the same, and it is hard to know where it is going. Yet, that is our job as Members of the United States House of Representatives. We were sent here by our constituents to lead our nation into the future, securing the livelihoods of each person we represent as well as protecting and maintaining the competitive edge of our nation in the emerging global knowledge economy.

None of us in Congress have time to analyze scientific and technological advances and make reasoned, logical determinations of their direction and impact on industry, nations, and education, but we vote on decisions about topics on a regular basis that include technical or scientific components. The connections to science and

technology are not always obvious, especially to Members who avoid science and technology, which are most Members. We cannot do this alone.

Congress used to have an in-house professional office dedicated to providing technological assessment services. Congress received regular reports in a legislatively relevant form on such subjects as agriculture technology, alternative fuels, arms control, banking, business and industry, communications, climate change, computer security & technology, defense technology, economic development, education, energy efficiency, the fishing industry, health and health technology, international relations and technology transfer, natural disasters, nuclear energy, nuclear war & nuclear weapons, oceans and oceanography, oil, gas, and mineral resources, transportation, and waste management. Congress decided in 1995 that we did not need an in-house body dedicated to technological assessment.

The technical assessment could come, we told ourselves (before my time here), through committee hearings, CRS reports, experts in our district, think tanks, and the National Academy of Sciences. Now, you and I each know that Members of Congress have a low comfort level with technology and are generally unable to probe beyond our personal understanding or the briefing books crafted by our staffers. In the ten years since we said these various groups would provide the technical advice we need, we have not gotten what we need in order to do the people's work. We should acknowledge that.

The Congressional Research Service does a good job of gathering the current information from a myriad of sources and presents the issues clearly in its reports. The GAO has taken upon itself to do some technical assessments. Some of us represent districts rich in scientific and technological expertise, in business, academia, or national laboratories and we informally or formally draw on the knowledge of our constituents. The National Academy of Sciences has the National Research Council, which completes studies for the Federal Government including recommendations of actions to be taken by the agency or branch of government. Some professional societies have started to reach out to Congress, and you will hear from the American Association for the Advancement of Science and the American Chemical Society today about what they do for Congress as far as technical or scientific advice or assessments.

We do not suffer from a lack of information here on Capitol Hill, but from a lack of ability to glean the knowledge and to gauge the validity, credibility, and usefulness of the large amounts of information and advice received on a daily basis. Although we would like to believe that the scientific and technical advice and assessment provided from outside remains politically neutral, this is not necessarily the case. In general, groups tend to be slow in responding to real-time needs of Members of Congress or their staffers in terms of science and technology assessment or advice, they often do not know what is happening in the halls of Congress, and have their own agendas.

There are real gaps in what Congress gets.

We are not getting what we need.

We need unbiased technical and scientific assessments in a Congressional time-frame by those who are familiar with the functions, the language, and the workings of Congress. We had this for twenty-three years through the Office of Technology Assessment, commonly referred to as the OTA. Although the OTA had its detractors, the OTA was a part of the Legislative Branch of the U.S. Government and existed to serve the Congress in one manner: scientific and technical advice

for Congress. The OTA was able to elaborate on the broader context of an issue and inform the policy debate with assiduous and objective analysis of the policy consequences of alternative courses of action. The OTA expounded on the various outcomes given particular policy choices, at times extending beyond a mere technical analysis. In 1995 Congress defunded the OTA, and no group or combination of groups has been able to assume OTA's place as the provider of scientific and technical assessment and advice to Congress. To give you an idea, at a rapid glance at the list of the 703 reports produced by the OTA, there are dozens that are still relevant today. ``Potential Environmental Impacts of Bioenergy Crop Production,''' ``Innovation and Commercialization of Emerging Technologies,''' ``Retiring Old Cars: Programs to Save Gasoline and Reduce Emissions,''' ``Renewing Our Energy Future,''' and ``Testing in America's Schools: Asking the Right Questions,''' would all be OTA reports of use today.

Why is this of such importance to Congress? Why do we need specialized, in-house scientific and technical assessments and advice? I can think of three compelling reasons: science and technology pervade almost all issues before us, including many that are not recognized explicitly as technology issues; the language and technologies are specialized and complex, and require translation for Members and their staff; and Members think science and technology are for scientists and technologists, thus avoiding science and technology themselves. Every Member is aware of the social, economic, moral, and political aspects of each of the issues before us. Not so with scientific and technological aspects of the issues before us. Members duck those aspects of the issues, flee them, ignore them, and, perhaps most often, march off oblivious to them.

Decisions made about fisheries, biofuels, agricultural technologies, educational technologies, intellectual property rights, technology transfer, foreign aid, the health care system, and broadband communications, will determine the course of our nation. On the floor we recently have dealt with such issues as voting, missile defense, and net neutrality, each of which has technological components. This week we will vote on the ``U.S.-India Nuclear Cooperation Promotion Act,''' the ``Pension Protection Act,''' and the ``Carl D. Perkins Career and Technical Education Improvement Act,''' each with a technical component--some larger, some smaller, some obvious to Members, many not obvious. In the last few weeks, various committees have held hearings on subjects which contain scientific and technical components. The committees sometimes seem unaware that the subjects contain scientific and technological components. The Science Committee is of least concern; most Members recognize the technological aspects of the issues and get the help necessary. However, this may not be so true for other committees, all of which handle topics with scientific and technical components. For example, the Agriculture Committee recently held a hearing on ``Reviewing the Federal Farm Policy;'' the Appropriations Committee held a hearing on ``the Census;'' the Education and the Workforce Committee held a hearing on ``NCLB: Can Growth Models Ensure Improved Education for all Students;'' the Energy and Commerce Committee held a hearing on ``Expanding the Emergency Alert System;'' the Homeland Security Committee held a hearing asking ``Is Our Nation Prepared for a Public Health Disaster?'' the Small Business Committee held a hearing on ``The Effects of the High Cost of Natural Gas on Small Business and Future Energy Technologies;'' and the House Administration Committee held a hearing on ``Voting System Standards.'' We lack the scientific and technological analysis of each topic. OTA

could have provided this.

We, each day when we cast our vote, are deciding the future of our nation; we are deciding the future for our children, our grandchildren, and our great-grandchildren. We are creating a legacy for which history will hold us accountable. We failed to assimilate some of the culture and knowledge of the Native Americans into our own working schemas when we spread into their lands. I am told that when the Iroquois made decisions for their nation, they were looking ahead to make sure that every decision related to the welfare and well-being of the seventh generation to come, and that was the basis by which decisions were made. They asked themselves ``Will this be a benefit to the seventh generation?''

In our technologically advanced, short-focused society, we have lost long-term vision. Investment and decisions concerning science and technology require an understanding of the scientific and technological development process, a sense of responsibility to understand the potential policy outcomes of our decisions, and the understanding that the pay-offs might not come until the next generation.

We need to fill the gaps in our science and technology advice. Technology has been studied extensively by scholars, and the lessons are clear. If we are honest with ourselves, we don't need scholars to tell us we need help. We know it. We need a dedicated, in-house, permanently staffed organization. Each Member of Congress should be able to request a study. The management structure should be designed to deal adequately with the needs of Congress. Political neutrality must be protected. It should also be physically close to Congress. Studies must be useful to the Members of Congress and in time and in language to make them relevant.

Jack Gibbons, referring to the need for an in-house technology assessment organ, sometimes quotes poet Edna St. Vincent Millay:

``Wisdom enough to leech us of our ill
Is daily spun, but there exists no loom
To weave it into fabric. . .''

There is no shortage of information and no shortage of wisdom. We are swamped with experts. We need help in weaving it into policy-relevant fabric.

Biography for Rush Holt

Rush Holt, 57, is a resident of Hopewell Township, N.J. Born in West Virginia he inherited his interest in politics from his parents. His father was the youngest person ever to be elected to the U.S. Senate, at age 29. His mother served as Secretary of State of West Virginia and was the first woman to have held that position.

Rep. Holt earned his B.A. in Physics from Carleton College in Minnesota and completed his Master's and Ph.D. at NYU. He has held positions as a teacher, Congressional Science Fellow, and arms control expert at the U.S. State Department where he monitored the nuclear programs of countries such as Iraq, Iran, North Korea, and the former Soviet Union. From 1989 until he launched his 1998 congressional campaign, Holt was Assistant Director of the Princeton Plasma Physics Laboratory, the largest research facility of Princeton University and the largest center for research in alternative energy in New Jersey. He has conducted extensive research on alternative energy and has his own patent for a solar energy device. Holt was also a five-time winner of

the game show ``Jeopardy.''

An active Member of Congress and a strong voice for his constituents, Rep. Holt serves on two committees, including the Committee on Education and the Workforce and the House Permanent Select Committee on Intelligence. Holt is the only scientist and only Member from the New Jersey delegation to sit on the Intelligence Committee, where he serves as the Ranking Minority Member on the Intelligence Policy Subcommittee. He is also on temporary leave from a third committee, the House Committee on Resources. Holt is also a member of the bipartisan Commission on Congressional Mailing Standards or the ``Franking Commission.''

Holt has had the honor to serve on the National Commission on Mathematics and Science Teaching for the 21st Century chaired by former Senator and astronaut John Glenn and currently sits on several caucuses, including those on Renewable Energy, Sustainable Development, Alzheimer's, Diabetes, Biomedical Research, India and Indian-Americans, Hellenic and Greek-American affairs, Farmland Protection, Human Rights, and a Woman's Right to Choose. Rep. Holt is also a member of the New Democrat Coalition.

In only a short time, Rep. Holt has won several significant victories in Washington. He helped secure more than \$700 million in new federal funding for science and technology research. He passed an amendment to the Land and Water Conservation Fund providing millions in funding for protecting open space and he was instrumental in adding the lower Delaware River to the National Wild and Scenic River program. He also initiated a federal study to map the gene sequences of all potential biological weapons to help first-responders and law enforcement react more effectively in the event of biological attack and he commissioned a Congressional investigation into the care at 91 nursing homes in New Jersey following up on reports of negligence.

Rep. Holt has brought significant federal resources to New Jersey. He helped secure \$5.6 million for security improvements at the Naval Weapons Station Earle in Monmouth County, \$2 million to establish a Land Use Municipal Resource Center to help local communities fight sprawl, and \$500,000 for Hunterdon Medical Center to improve its emergency room facilities. Holt has also helped secure more than a hundred million dollars to improve roads, build libraries, and protect historic sites in the five counties he represents.

Throughout New Jersey's 12th district, Rep. Holt has developed a reputation as a tireless advocate for his constituents. He has assisted over five thousand constituents who have contacted his office with inquiries, producing resolutions for problems ranging from Medicare to veterans' health care to immigration. He has also made hundreds of school visits and held dozens of town meetings and forums on topics such as Homeland Security, Alternative Energy, Economic Growth, Prescription Drugs, Student Aid, Privacy, Long-Term Care, and Sprawl.

Rep. Holt has received numerous awards and citations for his work, including the Planned Parenthood Community Service Award, the Biotech Legislator of the Year, and the Science Coalition's Champion of Science award. The magazine Scientific-American has also named Holt one of the 50 national ``visionaries'' contributing to ``a brighter technological future.''

Rep. Holt is married to Margaret Lancefield, a physician and Medical Director of the Princeton charity care clinic. They have three grown children, Michael, Dejan and Rachel, and six grandchildren, Noah, Niala, Boaz, Varun, Cecile, and Rohan.

Discussion

Chairman Boehlert. Thank you very much, Dr. Holt, and you know what? It shows you how well we get along together, Democrat and Republican, New Jersey, New York. I thought that was an outstanding statement, maybe because I agree with it.

But I want to increase your comfort zone somewhat. I am proud to report that this committee and the professional staff has 14 Ph.D.s, 14. That is very impressive, and I am also proud of the fact that we are very active with a number of organizations in town, and you mentioned some of them, AAAS, American Chemical Society, in providing opportunities for Ph.D.s in various scientific disciplines to serve a year's fellowship on the Hill. It is a wonderful program, and so, we are making progress. We are moving in the right direction. That doesn't negate anything that you said in the statement. It just supplements what you said.

Mr. Holt. If I may, Mr. Chairman.

Chairman Boehlert. Sure.

Mr. Holt. I do want to emphasize that I am not worried about the Science Committee. I mean, I do hope that in future years, it will have leadership as good as it has had in this Congress. However, it is all of those other committees, all of those other Members, that I worry about.

Chairman Boehlert. That like to wade into the science pool of activity, and sometimes, well--we won't go into what some of the other committees do or fail to do.

Thank you very much for your outstanding statement. I do appreciate it. Does anyone have any particular questions for our colleague, who has got a very busy schedule?

Mr. Rohrabacher. Mr. Chairman.

Chairman Boehlert. We are going to provide you with a treat now, Dr. Holt. Mr. Rohrabacher.

Mr. Rohrabacher. I wonder if you could tell me what the budget was for the Office of Technology Assessment per year in the ten years prior to us eliminating it.

Mr. Holt. At the time it was--I don't have the exact figures, and perhaps, staff can help us here, but when OTA was defunded, it was never deauthorized, when it was defunded in 1995, the operating budget was something in the twenties of millions of dollars a year. I would argue a bargain at any price, but----

Mr. Rohrabacher. Did you ever request studies done by the Office of Technology Assessment?

Mr. Holt. I was not a Member of Congress. However, I used many of their studies.

Mr. Rohrabacher. I was, and I requested things, and they were always late, and often, they got us the material after the debate was already decided, and when the Republican majority came in in 1994, meaning the first year was '95, we were looking for the most inefficient things we could get rid of in Congress, in order to say that we are cutting back here, as well as in the rest of government, and the Members, by majority, found out that--and those of us who had used it--that this was one of the most inefficient operations that we had, and thus, deserved to be cut.

Mr. Holt. Well----

Mr. Rohrabacher. Over the objection of others, like the Chairman, et cetera, who didn't see that, but----

Chairman Boehlert. Let me point out, Mr.----

Mr. Rohrabacher. But the majority did believe that.

Chairman Boehlert. Mr. Rohrabacher, let me----

Mr. Rohrabacher. Yes.

Chairman Boehlert.--point out that not everyone looked at the picture and saw the same vision. There were a number of us who highly valued the outstanding work of the Office of Technology Assessment, and many of us felt that sometimes, while they were a little bit delinquent in responding to a particular request that you might have advanced, because they were getting so many requests, because it was very obvious that there was a need for the product they were producing, because they were getting so many requests for information. Members like me, who are just--I pride myself in being a pretty darn good generalist, but not a specialist in anything, and you know, I just sort of threw up my hands, and said where do I go for information. And I was not alone. A number of my colleagues did the same thing, and so, I would contend they were sort of overworked, and therefore, that is why they were somewhat delinquent.

Mr. Rohrabacher. Well, I would agree, Mr. Chairman, that, you know, your worldview sometimes, you know, affects your assessment of, not only the scientific assessment, assessment of how you should spend your money. I mean, I operate under the assumption that bureaucracy is the most effective method ever developed that can turn pure energy into solid waste, and if you couple that, you know, couple great scientists with bureaucracy, and you are expecting to get something out of it more effective than what other bureaucracies produce, I think it really is wishful thinking, and I think, by experience, those of us who voted to eliminate the program, or eliminate funding for it, realized that asking consultants on the outside to do the same job was actually more cost-effective, and you actually had more control on them than you did once you hired someone as a government employee, and anyway, I would just say that, although we all agree that science is important, and making sure that we try to get nonpartisan assessments is important, certainly we shouldn't give up our analysis of what happens to even scientists when they become bureaucrats, and part of this bureaucracy----

Chairman Boehlert. I was----

Mr. Holt. I would like to address----

Chairman Boehlert. Mr. Gordon is most anxious to have an intervention, also, but----

Mr. Holt. I am not here, and I don't think the witnesses are here, to re-fight old battles. I do think that we have now 10 years of data, and it is pretty clear to me, since I have been here most of those ten years now, that we have not gotten the kind of technological assessment and advice that we told ourselves we would be able to get through other methods. So, it hasn't worked over the last 10 years. Now----

Mr. Rohrabacher. Could you give me some examples of that?

Mr. Holt. There may be some----

Mr. Rohrabacher. Well, a couple examples.

Mr. Holt. Sure. How about, let me see, do I have today's--

--

Mr. Rohrabacher. Well, we have got global warming advice coming out our ears, of course, by everyone who is being paid to give us that advice, but go ahead.

Mr. Holt. Yeah. Well, I will illustrate this in a way.

Chairman Boehlert. I told you it would be an interesting intervention.

Mr. Holt. Not to harp on OTA, but to make the point that we still have a crying need for policy-relevant, I would argue in-house, but at least policy-relevant technological assessment and advice, let me also address your point about the timeliness of the reports we got from OTA.

We got reports from OTA on adverse reaction to vaccines, computer software and intellectual property, saving energy in U.S. transportation, retiring old cars, export controls and nonproliferation policy, electronic surveillance in a digital age. Let me suggest to the gentleman that those reports were so timely that they are still useful today. Now, maybe you didn't get it on the week that you wanted it, but these are reports that are still useful today.

Mr. Rohrabacher. Some of those reports may have been given to us after we had the vote in Congress on the issue.

Mr. Holt. But my point----

Mr. Rohrabacher. That is the important point.

Mr. Holt. My point to the gentleman is we have not yet resolved the issues of adverse reactions to vaccines, intellectual property and computer software, saving energy in U.S. transportation, retiring old cars, export controls and nonproliferation policy, electronic surveillance in a digital age. We still need those reports, and in fact, we are still using them.

Mr. Rohrabacher. Thank you.

Chairman Boehlert. Mr. Gordon.

Mr. Gordon. Just briefly, I know, I disagree with my friend from California, Mr. Rohrabacher, but I don't disagree with his sincerity. I know that he is sincere in these issues, so I am not going to try to get into an argument, because we are not going to change anybody's mind.

But let me just again point out that if there was a problem with timeliness at OTA earlier, the problem, I think, as the Chairman pointed out, was it was underfunded and over-requested, which demonstrates, you know, it was the wrong reaction. We should have increased the funding, and I think by having good information, we would have saved the country money.

And I particularly have to disagree that we want to--with Mr. Rohrabacher's announcement that we need to contract these things out, so we would have more control over them. We don't want to have more control over them. We want to have good, you know, solid scientific information.

Again, he is sincere, Mr. Holt is sincere, I think. Nobody would be at this stimulating meeting today, if they weren't sincere.

Mr. Rohrabacher. Well, would the gentleman yield for just one moment.

Mr. Gordon. And so----

Mr. Rohrabacher. Would the gentleman yield?

Mr. Gordon. Certainly, certainly.

Mr. Rohrabacher. What I have been told is the budget over a ten year period was \$200 million, and they had two hundred employees in, you know, the Office, and that is an awful lot of consulting work that we could have had done for \$200 million--
--

Mr. Gordon. Well, that is \$20 million a year.

Mr. Holt. Yes, it was about \$20 million a year in those years' dollars, at its peak, 143 employees, I am told.

Chairman Boehlert. Thanks. Anyone else? All right. Thank you very much, Dr. Holt.

We could have a spirited, over a cup of coffee, discussion with Mr. Rohrabacher and our colleagues on the Committee, because for the benefit of the audience, this is the type of conversations we oftentimes will have on the floor, and Dana Rohrabacher and I don't always see eye to eye, but we always agree to have a nice friendly little chat about such things as global climate change, which he thinks is a figment of my imagination, but thank you, Dr. Holt, and thank you, Mr. Rohrabacher, for the intervention.

Now, our second panel, and here is what I would like to do. I ask unanimous consent that Dr. Holt be permitted to sit with the Committee, and participate in the questioning. Without objection, so ordered.

Now, panel number two. Dr. Jon Peha, Department of Engineering and Public Policy, Carnegie Mellon University. Dr. Al Teich, Director, AAAS Directorate for Science and Policy Programs, American Association for the Advancement of Science. Dr. Peter Blair, Executive Director, Division on Engineering and Physical Sciences, the National Research Council, and Dr. Catherine T. Hunt, the Leader of Technology Partnerships, Rohm and Haas Company.

Panelists, thank you so much for being facilitators for the Committee, information sources. We really appreciate your preparing for this hearing, and providing testimony. Your complete statements will be included in the record at this juncture. We would ask that you try to summarize them, so that we could have the benefit of a dialogue, conversations with Congress. Thanks so much.

Dr. Peha, you are first.

Panel II:

STATEMENT OF DR. JON M. PEHA, PROFESSOR, DEPARTMENTS OF ENGINEERING AND PUBLIC POLICY AND ELECTRICAL AND COMPUTER ENGINEERING, CARNEGIE MELLON UNIVERSITY

Dr. Peha. So much for my mastery of technology.

Good morning. My name is Jon Peha. I am a Professor of Electrical Engineering and Public Policy at Carnegie Mellon University, and Associate Director for the Center for Wireless and Broadband Networking.

There may be no institution on Earth inundated with more unsolicited advice than Congress, so it should sound strange for me to say that Congress is not getting information that it needs, but that is precisely what I have come here to say.

You can master many complex issues by filling a table like this one with people who have competing interests, and watching

them argue their points of view. Unfortunately, this approach breaks down when the issue is highly technical. For example, in the current debate on network neutrality and the Internet, I have watched advocates from all sides advance their agenda by giving misleading simplifications of how the Internet actually works and what neutrality might mean. From that, I don't see how any non-expert could tell what the issue is about, much less what to do about it. I couldn't separate substance from rhetoric until I did my own assessment, rooted in the technology of the Internet.

With this kind of issue, Congress needs balanced analysis that identifies possible policy options, and pros and cons of each, without telling Congress what to do. Armed with this basic information, Members can listen to stakeholders and make their own decisions. But who can provide this basic background?

Congress can turn to CRS, CBO, or GAO, but this type of analysis is not within their traditional mission. They would have to build the capability. Congress has the National Academies, which can bring together leading experts who will collectively recommend a course of action. Such studies are valuable, but Congress often needs someone to frame the issue, not recommend a solution.

There are university faculties that try to advise Congress, and I hope we are useful. I spend a lot of time at this. But faculty are removed from Capitol Hill. We may not produce reports on the issues of greatest importance to Congress at the time of greatest need, or in the format that is useful to Congress, and thus far, Congress has not created mechanisms to help us do so. Moreover, without investigation, you can't know the professor is advancing a balanced assessment or personal agenda.

So, in short, there are information sources that produce thorough, accurate, and balanced reports, and sources that are attuned to the needs of the Congress, but there is a shortage of sources that do both, and Congress should fill this gap with a new program, either as a new agency, or inside an existing one.

Now, there are many ways to do this. I will focus here on four important qualities of an effective program. It should be responsive, credible, impartial, and independent.

So first, the organization must be responsive to the needs of Congress. To ensure this, there should be a core group of professionals who are ultimately responsible for all products, who interact regularly with Members and their staffs, and for whom Congress is the principal client and funding source.

Second, the organization should have credibility in technical communities, even from stakeholders who don't like the latest report. Since no one organization can have credible expertise in all areas, this organization must be able to draw on leading scientists and engineers as needed, and leaders of the organization should have strong professional credentials that will earn respect outside the Beltway.

Third, the organization must be impartial and appear to be impartial. To achieve this, it must develop procedures that include careful outside review. It must have leaders who understand balanced technology assessments and will make appropriate use of dissenting views, and it must have strong

bipartisan, bicameral oversight from Congress, to ensure that the interests of all Members are well served.

Finally, the organization must have the independence to release controversial studies without risk of elimination. The method of deciding which studies will be completed must be carefully designed to reflect the needs of both the majority and minority in Congress, and Congress should allocate budgets years in advance, so the organization can ride out one or two very controversial reports.

An organization with these qualities would help all Members of Congress. It would be an insurance policy against unintended consequences from complex legislation, and it would earn the praise of scientific professional societies and their members.

I commend the Committee for considering this issue, and I thank you for hearing my opinions.

[The prepared statement of Dr. Peha follows:]

Prepared Statement of Jon M. Peha

Good morning Mr. Chairman, and Members of the Committee.

My name is Jon Peha. I'm a Professor of Engineering and Public Policy at Carnegie Mellon University, and Associate Director of the Center for Wireless and Broadband Networking.

There may be no institution on Earth that is inundated with more unsolicited advice than Congress, so it could sound strange for me to say that Congress is not getting information that it needs, but that is precisely what I've come here to say.

You can master many complex issues by filling a table like this one with people who have competing interests, and watching them argue different sides of the issue. Unfortunately, this approach breaks down when the topic is highly technical. For example, in the current debate on ``network neutrality'' in the Internet, I've seen advocates from all sides advance their agendas by giving misleading simplifications of how the Internet actually works and of what ``neutrality'' might mean. From that, I don't see how any non-expert could tell what the issue is about, much less what to do about it. I could not separate substance from rhetoric until I did my own assessment, rooted in the technology of the Internet.

With this kind of issue, Congress needs balanced analysis that identifies possible policy options, and pros and cons of each, without telling Congress what to do. Armed with this basic knowledge, Members of Congress can listen to stakeholders, and make their own decisions about which policy is best overall. But who can provide this background?

Congress can always turn to CRS, CBO, or GAO, but this type of analysis is not within their traditional mission. They would have to build the capability. Congress also has the National Academies, which can bring together leading experts who will collectively recommend a course of action. Such studies are valuable, but the process can be slow and expensive, and Congress often needs someone to frame the issue, rather than recommend a solution.

Some university faculty try to advise Congress, and I hope we are useful. However, faculty are removed from Capitol Hill. We may not produce reports on the issues of greatest importance to Congress, at the time of greatest need in Congress, or in a form that can be easily used by Congress. Thus far, Congress has not created mechanisms that would help us do so. Moreover, without investigation, you cannot know

if a professor is offering a balanced assessment or advancing a private agenda.

In short, there are information sources that produce thorough, accurate, and balanced reports, and sources that are attuned to the needs of Congress, but there is a shortage of sources that do both. Congress should fill this gap with a new program, either as a new agency or inside an existing one.

There are many ways to do this. I will focus here on four important characteristics of an effective program. It must be responsive, credible, impartial, and independent.

First, the organization must be responsive to the needs of Congress. To insure this, there should be a core group of professionals who are ultimately responsible for all products, who interact regularly with Members and their staffs, and for whom Congress is the principal client and funding source, as with GAO or CBO.

Second, the organization must have credibility in technical communities, even from stakeholders who are not thrilled with any given report. Since no one organization can have credible expertise in all areas, this organization must be able to draw on the country's leading scientists and engineers whenever needed. Moreover, the leaders of this organization should have strong professional credentials that will earn respect outside the beltway.

Third, the organization must be impartial, and appear to be impartial. To achieve this, it must develop procedures that include careful outside review, both when framing the issues and when vetting the results. This organization must have leaders who understand what balanced technology assessments look like, and will make appropriate use of dissenting views. There must also be strong bipartisan bicameral oversight from Congress, to insure that the interests of all Members of Congress are well served.

Finally, the organization must have the independence to release controversial studies without risk of elimination. The method of deciding which studies will be completed must be carefully designed to reflect the needs of both the majority and minority in Congress. Moreover, Congress should allocate budgets years in advance, so the organization can ride out one or two reports that offend a powerful group.

An organization with these qualities would help all Members of Congress. It would be an insurance policy against unintended consequences from legislation involving science or technology. It would also earn praise from many scientific professional societies, and their members.

I commend the Committee for considering this important issue, and I thank you for inviting me to express my views.

<GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT>

Appendix 1: Published in Renewable Resources Journal, Vol. 24, No. 2,
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Science and Technology Advice for Congress:

Past, Present, and Future

Jon M. Peha

Legislation Blowing in the Wind

With visions of Hurricane Katrina dancing in their heads, many Members of Congress wanted to immediately push some kind of legislation that would save American lives in future disasters, but how? Disaster response is a complex matter. Katrina, like any problem that dominates the American news, produces a deluge of proposed ``quick fixes'' to be evaluated by Congress. When proposals involve science or technology, this can be difficult.

One problem Congress could address in the aftermath of Katrina is the wireless communications systems used by firefighters, paramedics, National Guardsmen, and other emergency responders. Search and rescue efforts often were crippled by failures in these systems. Some will now push for grants to local governments to improve technical ``inter-operability,'' i.e., the ability of responders in one agency to communicate with responders in another agency. After all, inter-operability failures cost lives on 9/11 [1], after Katrina, and on too many other occasions [2]. Others will push to take spectrum away from television broadcasters, because a portion of this spectrum would go to public safety. After all, there is good reason to fear that a dangerous shortage of public safety spectrum is coming [3]. However, the decisions are not simple. One company after another will tell Congressional staff of their alleged ``solution'' to inter-operability problems, if government agencies would only purchase their products. Other companies will describe how the release of television spectrum in the manner they propose would be the salvation of public safety, and by coincidence, the proposed change also will affect their commercial systems in subtle but important ways. It is hard for someone without technical expertise to make sense of all these claims. Worse yet, changes may have side effects. Some plans intended to make more spectrum available to public safety would accidentally create new inter-operability problems, and some plans intended to improve inter-operability would accidentally exacerbate a spectrum shortage [4,21]. Moreover, in preparing communications systems for the next hurricane, some issues could be even more important than either inter-operability or a potential spectrum shortage, but no one successfully has brought these issues to the attention of Congress. There may be no one with sufficient incentive to do so.

There is nothing unique about this drama. This year, almost every committee in Congress will face one or more issues that are similarly hard to disentangle without expertise in some area of science or technology. This includes issues related to energy, the environment, health care, food safety, national defense, homeland security, space exploration, intellectual property, transportation, and telecommunications, just to name a few. The majority of these typically are not labeled as ``science issues,'' and most do not go through the Science Committee.

Plenty of Input, Not Enough Clarity

Congress relies primarily on adversarial procedures that are honed for equitably setting priorities, in contrast with the very different forums of scientists, which are honed for advancing knowledge [5,6]. Congress must answer questions like `is it more important to reduce the cost of automobiles or to reduce gasoline consumption?' and `is it better to increase taxes or to cut programs?' Stakeholders from all sides of a debate make their case. Members of Congress, acting as representatives of their constituents rather than experts in any narrow

discipline, then adopt a position based on their own values and priorities. Debates continue until consensus emerges for a compromise between competing interests. All of this works well if Members of Congress have a clear understanding of the issues and tradeoffs. Understanding can be extremely difficult when issues are rooted in science or technology. Indeed, it can be hard for someone with no technical expertise to ask the right questions. Thus, as shown by the above example of communications systems for public safety, Congress may need assistance in framing and prioritizing the fundamental problems, identifying the legislative options, assessing advantages and disadvantages of each option, and calling attention to any unintended side effects. With this information, Members of Congress of all political persuasions can apply their own values, and make informed decisions. Unfortunately, Congress has no reliable source for this kind of assistance on technical issues.

This does not mean Congress has no information. Indeed, Capitol Hill is overflowing with lobbyists who are prepared to tell Members of Congress how to vote and why. While input from stakeholders and their representatives is essential, it clearly is no substitute for the kind of impartial assessment described above. Members of Congress also can turn to a cadre of dedicated and intelligent staff. However, given the tremendous range of issues that Congress must address, most Congressional staff are generalists whose primary expertise is the legislative process, rather than any scientific discipline. Alternatively, Members of Congress can seek advice from one of their support organizations: the Congressional Research Service (CRS), the Congressional Budget Office (CBO), or the Government Accountability Office (GAO). While each of these organizations plays an important role, and all are in a good position to understand Congressional needs, the detailed assessment of technical issues simply is not part of their historical mission, so they traditionally have not built staff expertise, institutional mechanisms, or credibility in this area [7]. Of course, Congress may be changing that tradition--an option that will be discussed later.

Another important source of information on issues related to science and technology is the executive branch agencies, many of which have significant expertise. However, the U.S. system is based on checks and balances, and Congress is obligated to oversee the activities of the executive branch. Meaningful oversight is impossible without independent expertise. For example, Congress cannot oversee the Nation's finances if they depended entirely on the White House for analysis, which is why Congress has a Congressional Budget Office that is completely independent of the White House Office of Management and Budget. Unfortunately, on matters related to science and technology, Congress has no comparable support.

There still are more sources of information outside of government. These tend to be inappropriate for different reasons. The National Academies sometimes are an excellent resource for Congress [8], but for a different purpose. The National Academies generally attempt to bring diverse experts together to produce a consensus recommendation about what Congress should do. In many cases, Members of Congress do not want to be told what to do. Instead, they want a trustworthy assessment of their options, with the pros and cons of each, so they can make up their own minds. Universities and research institutes also produce valuable work on some important issues, but it rarely is generated at a time when Congress most needs it, or in a format that the overworked generalists of Congress can readily understand and apply. Moreover,

Members of Congress must be suspicious that the authors of any externally produced report have an undisclosed agenda.

In short, there is a fundamental gap in the information available to Congress. There is no consistent source of in-depth assessments that are balanced, complete, impartial, and produced at a time and in a format that is sensitive to the specific needs of Congress [9]. CRS reports are sensitive to Congressional needs and are designed to be impartial, but, by design, are limited in scope and depth. Partisan input also can be sensitive to the needs of Congress, but it is never impartial. Other information produced outside of Congress tends to be far less sensitive to Congressional needs, and the majority of it advocates for particular positions rather than merely providing a baseline assessment.

The Controversial History of Technology Assessment

There have been notable attempts to fill this gap. The flagship solution was the Office of Technology Assessment (OTA), a stand-alone organization that worked specifically for Congress, like CRS, CBO, and GAO. OTA produced roughly 750 reports during its 23-year lifespan, many of which were rigorous, respected, and widely cited by both supporters and opponents of the controversial measures that these reports addressed. Using OTA as a model, many nations have created similar organizations to advise their national legislatures [10]. While OTA had its supporters, it also had some severe critics, and this would ultimately be the organization's undoing. When Republicans took control of the House of Representatives in 1995 after four decades in the minority, they eliminated OTA.

Some of the reasons for eliminating OTA had little to do with its effectiveness. While the Republicans were in the minority, they often had called for the elimination of various government programs and agencies. When they became the majority party in the House, they were under great pressure to follow through on these promises, but it was not easy to eliminate big targets like the Department of Education. Ultimately, they would succeed in eliminating exactly one agency--OTA--giving it great symbolic importance.

Nevertheless, the debate over OTA was not all symbolism. Some Members of Congress raised noteworthy concerns. The most serious allegation was bias. It is not surprising that the party in the minority (before 1995) would raise concerns about bias, given that the other party had dominated Congress throughout OTA's existence. For example, some conservatives claimed bias in a series of OTA reports that questioned the technical feasibility of the Strategic Defense Initiative (SDI) (dubbed ``Star Wars'' in the press) [11-14]. SDI was intended to shield America from incoming missiles. To the horror of then-President Ronald Reagan and his supporters in Congress, OTA concluded that the SDI vision of protecting all Americans from Soviet missiles was ``impossible to achieve.''' [12]

Two decades later, the debate continues over whether OTA was biased, but this debate is largely irrelevant. Regardless of whether the bias concern was rooted in reality, appearance, or fabrication, the lessons are the same. Bias or the appearance of bias can be devastating. An organization designed to serve Congress must be both responsive and useful to the minority, as well as the majority. Representatives of both parties and both houses must provide careful oversight, so that credit or blame for the organization's professionalism is shared by all.

The most likely way for bias to arise is in the selection of issues to be investigated. Consequently, both parties and both houses must have significant say in this selection. Shared oversight can prevent a pattern of bias across many issues, but if an unbiased organization is doing its job well, there still will be individual reports that anger one group within Congress. As long as there was no bias in the selection of topics, all reports will not displease the same group. Consequently, the organization must be constructed in such a way that the furor over any one or two controversial issues is likely to die down before angry partisans can eliminate the agency. For example, funding and staff levels might be fixed four years ahead of time, instead of just one year.

Probably the most frequent criticism of OTA from supporters and detractors alike is that it was too slow; some studies took so long that important decisions already were made when the relevant reports were released. Many have argued that any future organization must be faster. This may be the case, but there are more important lessons here. Good work takes time, particularly if Congress is expecting a broad scope, and extensive depth. However, this is not always the case. Sometimes a Congressional Committee happily will accept a narrow scope or a significant amount of recycled content, if the report is available quickly. The most important lessons here are that an organization providing technology assessments must offer Congress a wider range of services with varying durations and scopes, and that it must be part of this organization's culture to listen carefully to its client (Congress) to understand the client's preferences for any given project.

A New Era for Technology Assessment

In June 2001, six years after OTA's demise, Carnegie Mellon University organized a workshop in Washington, D.C. on the state of science and technology information in Congress. The workshop drew leaders from both the scientific community and from Congress. Speakers from Congress included Representatives Sherwood Boehlert (R-NY), Vernon Ehlers (R-MI), Rush Holt (D-NJ), and Amo Houghton (R-NY). There was remarkably strong consensus that Congress needed new institutional support to provide advice on issues related to science and technology, although opinions differed on the ideal form of this support. Some preferred a return to the OTA model, and others preferred something quite different.

Six distinct approaches are discussed in detail in *Science and Technology Advice for Congress* [15], a book produced by many workshop participants. Two difficult questions divide many of these models: (1) should this technology assessment capability reside in an existing organization or a new organization, and (2) should its staff work directly for Congress or should there be institutional separation?

The problem with creating a new technology assessment capability and placing it in an existing organization, whether it is CRS or the National Academies, is that these organizations already have their own missions and their own cultures, which are not perfectly compatible with the technology assessment process. This clash can make it more difficult to do high-quality technology assessments. Moreover, if these assessments are viewed internally as a diversion from the organization's real mission, there is a danger that some important resources (e.g., staff, funding) will be directed elsewhere when budgets are tight. On the other hand, if this new program is a division

of an existing organization, there may be more opportunities to share scarce resources and expertise. Moreover, judging from the OTA experience, a stand-alone organization may be more vulnerable to complete elimination during heated controversies.

With regard to the second question of ``distance'' from Congress, some advocated that technology assessments be conducted within an organization that answers directly to Congress (i.e., GAO, CRS, CBO), or a new organization that is similarly constructed. Others wanted an organization (new or existing) that operates under contract to Congress, and perhaps to other clients as well, as the National Academies do today. The former would encourage staff to be more sensitive to the needs of Congress. It also could afford them less protection when bringing news that Members of Congress do not want to hear. Moreover, the staff size of a Congressional organization is always limited, making it difficult for this organization to have expertise in every topic of potential interest to Congress. By contracting work to outside organizations, talent can be drawn from a much larger pool. This issue becomes particularly important if the technology assessment effort is relatively small.

Given these tradeoffs, my proposal would create a hybrid, in which a small dedicated staff work on Capitol Hill directly for Congress [16]. Their job is to understand the needs of Congress, and to insure that all reports in their final form meet those requirements. However, much of the assessment work would be done by a collection of outside organizations, each of which would be certified every few years for competence, professionalism, and impartiality.

After the workshop, Senator Jeff Bingaman (D-NM) proposed the creation of a small pilot program in technology assessment. Thanks to bipartisan support in both the House and Senate, the pilot received \$500,000 of funding in the 2002 budget. Work began in March 2002, and GAO's first assessment on biometric technology for border security came out in November 2002 [17]. This was remarkably fast turn-around, especially given that GAO had no institutional experience with this kind of analysis. GAO also invited an external evaluation of their work from outside experts [18], which demonstrates seriousness about quality. (Most agencies avoid criticism rather than seek it). Other GAO technology assessments have followed [19,20].)

Early results are quite encouraging. Experience to date shows that a technology assessment program operating within GAO is capable of producing balanced, timely, and relevant reports containing a range of useful information on important issues before Congress. Not surprisingly, early results also show that improvement is possible and desirable, in large part because technology assessments differ substantially from the traditional GAO studies in intent, content, and process. Thus, for example, GAO must learn new methods of soliciting input from outside experts, framing a technology assessment, and subjecting work to fast but effective peer review. If Congress keeps funding this pilot, it is likely that GAO will continue to improve with experience.

This small pilot will do some useful work, and foreshadow the effectiveness of a program within GAO before making longer-term decisions. However, the GAO pilot cannot succeed in the long run if it remains a mere pilot. A technology assessment program must develop or recruit a staff that has strong credentials to impress both the scientific and Congressional communities, and significant expertise in science or technology, in communicating with Congress, and in technology assessment. Attracting, developing, and retaining

outstanding people with these diverse skills will not be easy for a program that could abruptly cease to exist with little warning.

Worse yet, should a technology assessment ever produce news that is unwelcome to any powerful group within Congress, there is little to protect the program from termination. Since management within GAO knows this, they might be tempted to avoid controversial issues, or worse yet, to dilute the conclusions of experts and staff members. If they succumb to this temptation, the program will be of limited effectiveness, and if they do not, the program will not survive for long.

Conclusion

When issues are rooted in science or technology, Members of Congress often need assistance in framing issues, identifying legislative options, and assessing all the pros and cons of each option, so they can make informed decisions that are consistent with their own values and priorities. Today, Congress has no reliable, impartial source available to provide detailed analysis of this type, with the possible exception of a limited pilot effort within GAO. It is time for Congress to move beyond pilots, and to establish a permanent technology assessment capability. When creating a permanent solution, the greatest challenges will be to ensure that this new technology assessment program has careful and balanced bipartisan and bicameral oversight, and that its staff and funding levels will remain stable, even through heated controversies and budget crises. Ideally, they should receive sufficient resources to offer a significant amount of support for Congress, but stability is more important than size.

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Appendix 2

For further discussion, please see the following book

Science and Technology Advice for Congress,

M.G. Morgan and J.M. Peha,
RFF Press, Washington, DC, 2003.

PUBLISHER'S SYNOPSIS:

The elimination of the Office of Technology Assessment (OTA) in 1995 came during a storm of budget cutting and partisan conflict. Operationally, it left Congress without an institutional arrangement to bring expert scientific and technological advice into the process of legislative decision-making. This deficiency has become increasingly critical, as more and more of the decisions faced by Congress and society require judgments based on highly specialized technical information.

Offering perspectives from scholars and scientists with diverse academic backgrounds and extensive experience within the policy process, Science and Technology Advice for Congress breaks from the politics of the OTA and its contentious aftermath. Granger Morgan and Jon Peha begin with an overview of the use of technical information in framing policy issues, crafting legislation, and the overall process of governing. They note how, as non-experts, legislators must make decisions in the face of scientific uncertainty and competing scientific claims from stakeholders. The contributors continue with a discussion of why OTA was created. They draw lessons from OTA's demise, and compare the use of science and technological information in Europe with the United States.

The second part of the book responds to requests from congressional leaders for practical solutions. Among the options discussed are expanded functions within existing agencies such as the General Accounting or Congressional Budget Offices; an independent, NGO-administrated analysis group; and a dedicated successor to OTA within Congress. The models emphasize flexibility--and the need to make political feasibility a core component of design.

Biography of Jon M. Peha

Jon M. Peha is Associate Director of the Center for Wireless and Broadband Networking at Carnegie Mellon University, and a Professor in the Department of Engineering and Public Policy and the Department of Electrical and Computer Engineering. He has addressed telecom and e-commerce issues on legislative staff in the House and Senate, and helped launch a U.S. Government interagency program to assist

developing countries with information infrastructure. He has also served as Chief Technical Officer of several high-tech start-ups, and as a member of technical staff at SRI International, AT&T Bell Laboratories, and Microsoft. Dr. Peha's research spans technical and policy issues of information networks. This has included broadband Internet, wireless networks, video and voice over IP (VOIP), communications systems for first responders for public safety and homeland security, spectrum management, universal service, secure systems for financial transactions over the Internet, e-commerce taxation and privacy, and network security. He holds a Ph.D. in electrical engineering from Stanford.

<GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT>

Chairman Boehlert. Thank you very much, Dr. Peha. Let me point out that sometimes, advice and information are two different things entirely.

Dr. Teich.

STATEMENT OF DR. ALBERT H. TEICH, DIRECTOR OF SCIENCE AND POLICY PROGRAMS, AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Dr. Teich. Mr. Chairman, Mr. Gordon, Members of the Committee, thank you for the opportunity to appear here this morning on behalf of AAAS.

AAAS, as you may know, is the world's largest multi-disciplinary scientific association. We were founded in 1848, and today represent roughly 10 million individuals who are members in our affiliated societies. We are also the publisher of the journal Science.

Congress today is addressing an increasing number of complex scientific issues. Last week alone, the House and its committees addressed, among other topics, stem cell research, climate change science, voting technology, fuel cells, and agricultural policy.

Few Members of Congress, with the notable exception of several Members of this committee, and relatively few Congressional staff, at least outside of this committee, have backgrounds in science. Do adequate resources exist for Congress to address these kinds of issues? From our perspective, the answer is no. Information is abundant, but objective, timely, policy-relevant analyses, which is what Congress really needs, are in short supply.

The increased use of technology and the Internet have revolutionized the way in which people and organizations communicate with elected officials. A recent study found that Congress received four times more communications in 2004 than it did in 1995. An average Congressional staffer, of which there are over 10,000, receives 200 emails a day from advocacy groups, constituents, and colleagues, and I suppose that doesn't even include advertisements for Viagra and other similar emails.

How can a Member of Congress, as busy as he or she is, digest this enormous amount of information, and separate the wheat from the chaff? Many scientific assessments are conducted

or funded by entities that have a financial or political interest in the issue at hand, and funding from such groups is often perceived to affect the study's findings. Conflicting reports from groups with different viewpoints can make it difficult to determine where the scientific consensus lies, particularly for those not deeply familiar with the scientific process.

Congressional support agencies, such as the Government Accountability Office, the Congressional Budget Office, and the Congressional Research Service, play an important role. Nonpartisanship, objectivity, and responsiveness to Members' requests make them valuable resources. Each one, however, has limitations when it comes to providing scientific and technical policy analyses, as I indicate in my written statement.

Though they are not Congressional support agencies, the National Academies and the National Research Council respond to approximately 10 to 20 Congressional requests for studies each year. Though reports can be completed quickly sometimes, often, the process takes twelve to eighteen months. These authoritative studies by distinguished scientific experts therefore tend to be most useful for in-depth treatment of long-term issues.

Other large-scale assessments, including international projects, such as the Millennium Ecosystem Assessment, the executive branch research efforts, such as the Climate Change Science Program, also provide in-depth studies, but again, not on a time scale that is consistent with the needs of Congress.

One resource available to Congress, as mentioned earlier, is the Congressional Science Fellows program. Begun by AAAS in 1973, the program today provides an opportunity for approximately 35 Ph.D. level scientists and engineers to work as professional staff in Congressional offices for a year. Fellows' stipends are paid by scientific societies, making them a free source of expertise for Members. Many Fellows catch Potomac Fever and remain in Washington as permanent Congressional staff, providing a scientific perspective on policy issues. Nevertheless, the relatively small number of Fellows means that the percentage of staff with scientific backgrounds remains low.

In recent years, universities and scientific societies, including AAAS, have expanded efforts to bring objective scientific information to Congress through reports on policy relevant topics and scientific briefings. These activities are often limited by funding. In addition, scientists are often cautious about providing policy analyses on scientific issues, sticking instead to providing data, limiting their ability to inform decisions in a meaningful way.

To sum up, information is not in short supply on Capitol Hill, as you, Mr. Chairman, indicated, but information is not knowledge. Credible sources are needed to provide timely analysis and synthesis of scientific and technical information as a foundation for Congressional decisions.

These concerns are not new, as Mr. Gordon mentioned in his statement. Back in 1970, and in fact, previous to that even, at least in 1970, a study of Congress found that it lacked ``independent sources of scientific and technical advice.'' This realization led to a number of important organizational

innovations. The even greater role of science and technology in today's society demands that Congress seek innovative methods suited to 21st Century needs to obtain objective, timely, policy-relevant analyses, that is, knowledge that Members can use.

AAAS and the scientific community stand ready to help in this vital endeavor. Thank you very much for allowing me to express my views.

[The prepared statement of Dr. Teich follows:]

Prepared Statement of Albert H. Teich

Thank you for the opportunity to appear before you today on behalf of the American Association for the Advancement of Science (AAAS) to discuss scientific and technical advice for Congress. AAAS is the world's largest multi-disciplinary scientific society and publisher of the journal Science. AAAS was founded in 1848, and represents roughly 10 million individuals through its members, affiliated societies and academies of science.

Congress is increasingly addressing complex scientific issues. Last week alone, the House and its committees addressed--among other topics--stem cell research, climate change science, voting technology, fuel cells, and agricultural policy. Over the past year, the list expands to include intellectual property, avian influenza, bioterrorism threats, research priorities in aeronautics, and ocean resource management.

Few Members of Congress, with the notable exception of several Members of this committee, and relatively few congressional staff, have backgrounds in science. Do adequate resources exist for Congress to address these issues? From our perspective, the answer is no. Information is abundant, but objective, timely, policy-relevant analyses are in short supply.

The increased use of technology and the Internet have revolutionized the way in which people and organizations communicate with elected officials. A recent study found that Congress received four times more communications in 2004 than it did in 1995. Virtually all of this increase is from Internet-based communication. The average congressional staffer (of which there are over 10,000) receives 200 e-mails each day from advocacy groups, constituents, and colleagues.\1\

\1\ Fitch, Brad and Nicole Griffin, Communicating With Congress: How Capitol Hill Is Coping With the Surge in Citizen Advocacy, Congressional Management Foundation, 2005.

How can a Member of Congress, as busy as he or she is, digest this enormous amount of information, and assess its validity? Many scientific assessments are conducted or funded by entities that have a financial or political interest in the issue at hand. Funding from such groups or organizations is often perceived to affect the study's findings. Conflicting reports from groups with different viewpoints can make it difficult to determine the scientific consensus, particularly for those not deeply familiar with the nature of science, the peer-review process, the definitions of scientific consensus, and principles of uncertainty.

Furthermore, a key challenge for members and their staffs is to use the information and assistance provided by interest groups without becoming bound to their agendas. In the words of one observer,

``interest groups usually have their own ideas about proper allocation, and they seldom coincide with Congressmen's predilections.'' \2\

\2\ Arnold, R. Douglas, ``The Local Roots of Domestic Policy,' in Thomas E. Mann and Norman J. Ornstein (eds.), *The New Congress* (Washington: American Enterprise Institute, 1981), pp. 250-287.

Nonpartisanship, objectivity, and responsiveness to Members' requests make Congressional support agencies, such as the Government Accountability Office (GAO), the Congressional Budget Office (CBO), and the Congressional Research Service (CRS), valuable resources, though they are not solely dedicated to science and technology. One explanation of Members' overall positive appraisal for the agencies may lie in an observation by Davidson and Oleszek:

``Unlike committee or personal aides, these agencies operate under strict rules of nonpartisanship and objectivity. Staffed with experts, they provide Congress with analytical talent matching that in executive agencies, universities, or specialized groups.'' \3\

\3\ Davidson, Roger H. and Walter J. Oleszek, *Congress and Its Members*, 3rd ed. (Washington, DC: CQ Press, 1990).

CRS reflects its base in the Library of Congress by providing quick responses to thousands of congressional requests annually for factual information, as well as providing policy research and analysis. Its reports are useful, but its ability to provide synthesis is limited. Though it has the ability to conduct scientific and technological assessments, GAO's work reflects its traditional major focus-- eliminating waste and fraud and improving program performance. At its current staffing levels, GAO can only complete one to three technology studies per year.\4\

\4\ Kelly, Henry et al., *Flying Blind: The Rise, Fall and Possible Resurrection of Science Policy Advice in the United States*, Federation of American Scientists, 2004.

Though they are not congressional support agencies, the National Academies and National Research Council respond to approximately 10-20 requests for studies from Congress each year. Though reports can sometimes be completed quickly, the process generally takes 12-18 months. These authoritative studies that involve distinguished scientific experts writing peer-reviewed reports tend to be most useful for in-depth treatment of long-term issues.

Other large-scale assessments, including international projects such as the Millennium Ecosystem Assessment and Intergovernmental Panel on Climate Change (IPCC), provide in-depth assessments of the current state of knowledge on broad topics. The IPCC aims to provide information that is policy relevant but not policy prescriptive. Similarly, ongoing executive branch research efforts such as the Climate Change Science Program use experts to determine the scientific consensus on key issues. However, these large-scale projects are seldom conducted on a time scale that is consistent with the needs of Congress.

One resource available to Congress is the Congressional Science Fellows program. Begun in 1973 by a group of scientific and engineering

societies led by AAAS, this program provides an opportunity for approximately 35 Ph.D.-level scientists and engineers to work as professional staff in congressional offices for a year. Fellows' stipends are paid by scientific societies, making them a free source of expertise for Members. Many Fellows catch ``Potomac Fever'' and remain in Washington as full-time congressional staff, continuing to provide a scientific perspective on policy issues.

Over the years, many Members of Congress have indicated how valuable they find the program. For example Rep. John Peterson (R-PA) noted that ``Congressional Fellows have played a key role on my staff. . .and the knowledge and expertise which they bring to the table has been a tremendous asset when dealing with science and technology issues.'' Senator Harry Reid (D-NV) added that Fellows in his office ``have made critical contributions to a wide range of legislative and oversight projects, including health, environmental, educational, technological, economic and security issues.'' Nevertheless, the relatively small number of fellows means that the percentage of staff with a scientific background remains low.

Universities and scientific societies, including AAAS, have expanded efforts to bring accurate scientific information to Congress through reports on policy-relevant topics, position statements, and scientific briefings. These activities are often limited by funding. In addition, scientists are often cautious about providing policy analysis on scientific issues, sticking instead to providing scientific data, limiting their ability to inform decisions in a meaningful way.

To sum up, information is not in short supply on Capitol Hill, but information is not knowledge. Credible sources are needed to provide timely analysis and synthesis of scientific and technical information as a foundation for Congressional decisions.

These concerns are not new. A 1970 report found that Congress lacked sufficient ``independent sources of scientific and technical advice.'' \5\ This realization led to a number of important organizational innovations. The even greater role of science and technology in today's society demands that we seek innovative methods suited to 21st Century needs to provide Congress with objective, timely, policy-relevant analyses--that is, knowledge that Members can use.

\5\ von Hippel, Frank and Joel Primack, *The Politics of Technology: Activities and Responsibilities of Scientists in the Direction of Technology* (Stanford, 1970)

About the American Association for the Advancement of Science (AAAS)

The American Association for the Advancement of Science (AAAS) is the world's largest multi-disciplinary scientific society and publisher of the journal *Science* (www.sciencemag.org). The non-profit AAAS (www.aaas.org) is open to all, and our members come from the entire range of science and technology disciplines. *Science* has the largest paid circulation of any peer-reviewed general science journal in the world, with an estimated total readership of over one million. AAAS fulfills its mission to ``advance science and serve society'' through initiatives in science education; science policy; international programs; and an array of activities designed both to increase public understanding and engage the public more with science. Programs designed to provide Congress with scientific resources include:

AAAS Science & Engineering Policy Fellowships. The Science & Technology Policy Fellowships (<http://fellowships.aaas.org/>) began in 1973 with seven Fellows serving in congressional offices, providing their scientific expertise to policy-makers facing increasingly technical legislative issues. The ensuing decades have led to the establishment of AAAS Science & Technology Policy Fellowships in nearly a dozen executive branch agencies.

The fellowships provide the opportunity for scientists and engineers, from recent Ph.D. recipients to senior-level professionals, to learn about policy-making while contributing their knowledge and analytical skills to the Federal Government. About 30 other scientific and engineering societies participate, selecting and funding their own Fellows.

The Fellows, representing a broad array of science and engineering fields, bring a common interest in learning about the intersection of science and policy, and a willingness to apply their technical training in a new arena. The host offices value the Fellows for their external perspectives and critical thinking skills, as well as for their technical expertise.

Center for Science and Technology in Congress. The Center for Science, Technology, and Congress (<http://www.aaas.org/spp/cstc/>) is one of the principal channels for AAAS communication between the scientific community and the legislative branch of the U.S. Government. It was established in 1994, under an initial grant from the Carnegie Corporation of New York. The Center's primary function is to facilitate communication between the science and engineering community on the one hand and the legislative community and the public it represents on the other.

AAAS's inclusiveness and breadth of coverage among fields of science and engineering enable it to both draw upon and reflect the views of virtually the entire science and technology enterprise. The Center's multi-faceted strategy is a strong example of how AAAS approaches its mission and long-term goals. It reports on S&T-policy relevant news through the monthly newsletter Science & Technology in Congress; the Center organizes congressional briefings; it provides Policy Briefs on critical scientific issues facing policy-makers; and it assists in the preparation of AAAS formal statements and resolutions, congressional testimony, and letters to the executive and legislative branches of governments. Its activities reach out to Members of Congress and staff, AAAS affiliates, academic institutions, science attaches, and the media.

Center for Science, Technology, and Security Policy. The Center for Science, Technology and Security Policy (<http://cstsp.aaas.org/>) was established by the AAAS through support from the Science, Technology & Security Initiative at the MacArthur Foundation. The goal of the Center is to encourage the integration of science and public policy for enhanced national and international security. The Center acts as a portal that facilitates communication between academic centers, policy institutes, and policy-makers.

The Center speeds the delivery of balanced technical analysis to Congress, Executive Branch agencies and the public at large through monthly briefings, special reports from panels of technical experts, and partnerships with the broad international network of leading universities, think-tanks, professional societies and nongovernmental

organizations.

R&D Budget and Policy Program. Every year since 1976, AAAS has published a report analyzing research and development (R&D) in the proposed federal budget in order to make available timely and objective information about the Administration's plans for the coming fiscal year to the scientific and engineering communities and policy-makers. At the end of each congressional session, AAAS publishes a report reviewing the impact of appropriations decisions on research and development, entitled Congressional Action on Research and Development in the Budget. AAAS has also established a website (www.aaas.org/spp/R&D) for R&D data with regular updates on budget proposals, agency appropriations, R&D trends in past years, and outyear projections for R&D, as well as numerous tables and charts.

Biography for Albert H. Teich

Albert Teich is Director of Science & Policy Programs at AAAS, a position he has held since 1990. He is responsible for the Association's activities in science and technology policy and serves as a key spokesperson on science policy issues. Science and Policy Programs, which includes activities in ethics, law, science and religion, and human rights, as well as science policy, has a staff of 40 and a annual budget of about \$9 million. He also serves as Director of the AAAS Archives.

He received a Bachelor's degree in physics and a Ph.D. in political science, both from M.I.T. Prior to joining the AAAS staff in 1980, he held positions at George Washington University, the State University of New York, and Syracuse University. Al is the author of numerous articles and editor of several books, including Technology and the Future, the most widely used college textbook on technology and society, the tenth edition of which was published by Thompson Wadsworth in 2005.

Al is a Fellow of AAAS and the recipient of the 2004 Award for Scientific Achievement in Science Policy from the Washington Academy of Sciences. He is a member of the editorial advisory boards to the journals Science Communication; Science, Technology, and Human Values; Prometheus; and Renewable Resources and a consultant to government agencies, national laboratories, industrial firms, and international organizations. He is a Past Chair of the Board of Governors of the U.S.-Israel Binational Science Foundation, where he remains a member of the executive committee; a member of the External Research Advisory Board of the University of California at Davis, the Norwegian Research and Technology Forum in the United States, and the National Research Council's Research and Technology Transfer Committee.

Al is married to Jill H. Pace, Executive Director of the American College of Real Estate Lawyers. He has three children and three grandchildren. He is an accomplished amateur photographer, has published several photographs, and had a one-man show of his photographs at the Black & White Gallery in Arlington, Virginia, in 2005, and another in the AAAS Science and Art Exhibition Gallery in 2006.

<GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT>

Chairman Boehlert. Thank you very much, Doctor, and just let me point out, and I think on behalf of the entire Committee, both sides of the aisle, the AAAS Fellows program is

a wonderful program that is warmly embraced by all.

But it is a two way street, and I would suggest that some of the Fellows who come up, as you say, get Potomac Fever and they stay, and that is good, because that helps us be better informed. There are some in our committee and in our respective individual offices, but most of the AAAS Fellows go back from whence they came, into the community. And that is good for science, because I find, in most instances, science, scientists are not particularly effective at lobbying for their interests. They need guys like me to be lobbyists, because well--and Mr. Gordon.

So, it works well. So, you have a better appreciation for how the political process works, and--because of the Fellows coming back, and the Fellows who we retain guide us, and we have a better appreciation for the science of the subject matter we are dealing with. So, keep it up please.

Dr. Teich. Thank you.

Chairman Boehlert. Expand it, if anything.

Dr. Blair.

STATEMENT OF DR. PETER D. BLAIR, EXECUTIVE DIRECTOR, DIVISION
ON ENGINEERING AND PHYSICAL SCIENCES, NATIONAL ACADEMY OF
SCIENCES

Dr. Blair. Thank you for the invitation to testify today about science and technology assessment advice to the Congress. The subject is certainly a longstanding one with me, that I have seen from different perspectives in my professional life. So I appreciate the opportunity to share those experiences and perspectives with you and the Committee.

The breathtaking pace of science and technology over the past half-century has delivered both staggering benefits to society as well as sobering challenges associated with the role of technology in virtually every aspect of our lives. Society, in reaping the benefits, must also be able to cope with the challenges.

Indeed, among the Founding Fathers' deepest concerns about the fledgling American democracy was that it could function well only when the electorate, and in particular, its institutions of government, are well informed about the issues upon which it must decide. On the slide are Mr. Madison's sentiments on the matter.

Because science and technology issues, perhaps in particular, are so complex, or often so complex, and have such impact on society, a government poorly informed on such issues is destined to make bad policy choices. Yet today, it is becoming increasingly difficult for anyone, or even any institution, to keep pace with the frontier of scientific knowledge. So how, then, can the Congress acquire useful, relevant, informed, independent, objective, authoritative, and timely advice on science and technology dimensions of the issues it faces?

The information revolution has dramatically expanded the quantity of information available to the Congress, but more has not proved necessarily to be better. Indeed, a fundamental problem today is not the quantity of information at all, but rather, how to gauge validity and usefulness within the flood

of available information, advice, and advocacy.

Another way to put this is Will Rogers' old observation that ``What gets us into trouble isn't so much what we don't know, it is what we know for sure that just ain't so.'' The former chairman had a similar perspective called a defense against the dumb.

Congress certainly has many possible resources at its disposal, such as universities, think tanks, the professional societies, trusted constituents, existing Congressional agencies, and of course, the National Academies. My colleagues on the panel will explore some of these options, so I will focus on three points.

First, the current and evolving role of the Academy in providing advice to the Congress through its--principally, through its operating arm, the National Research Council. Second, what I consider to be an especially important gap in the sources of advice available to the Congress, and third, some concluding thoughts on the options.

As an additional and more detailed discussion, I refer to a report, ``Scientific Advice for Policy in the United States: Lessons from the National Academies and the Former Congressional Office of Technology Assessment,'' which I would like to include for the hearing record. In that document, and also, in my written statement, I recap for you the charter of the Academies, and how today, our studies continue to be among those most familiar and respected sources of independent scientific advice to the Congress.

Indeed, Academy committees produce over two hundred reports annually, of which between 15 and 25 a year are mandated by Congress, which means that while the Academy is a substantial enterprise in the science and technology advice world overall, its role specifically for the Congress is actually a relatively small part of the portfolio. We could do more, and indeed, as my colleagues on the panel will attest, the entire science community could do much more.

The key strengths of the NRC in providing advice to the Congress are principally threefold. First, the long established reputation for credibility, enhanced by its association with the prestigious memberships of the Academies. Second, a historical ability to convene leading experts, and third, a well established and respected study process, designed to maintain balance and objectivity throughout a study committee's work, that produces reports considered to be both unbiased and authoritative.

The resulting NRC study reports often serve an important need of Congress, that is, an authoritative set of consensus findings and recommendations from a widely recognized group of experts, often leading to a specific recommended course of action. Some of the sample reports shown on this slide should be very familiar to this committee, you have talked about just in recent weeks, and one the chairman mentioned a while ago.

Nonetheless, like any process designed to serve many needs, the NRC study process is not perfectly tuned to serve all government needs. For example, our process is less well equipped, currently, to go beyond technical analysis, to gauge the broader policy implications of alternative actions, especially those implications that may involve fundamental

value judgments or tradeoffs for which it may be difficult to impossible to achieve consensus. In short, and at some risk of being simplistic, what seems to be missing is a mechanism to inform the Congressional debate, including perspectives that may go beyond science and technology to include the broader implications of alternative actions related to science and technology issues being considered, and especially, a comprehensive evaluation of such perspectives. In the question period, I would be happy to offer some examples.

In my view, both of these kinds of analysis, that is, both the traditional NRC study and this new type of study I am talking about, are important to Congressional deliberations. Since the closure of OTA now a decade ago, this latter type of analysis, as performed by a disinterested, analytical organization tuned specifically to the needs of Congress, is not readily accessible to the Congress.

Such a function may need to be reconstructed in some way, through adapting an existing organization, or through creation of a new organization answerable directly to the Congress, or perhaps by creating a new process within an existing Congressional agency. There are some experiments underway at GAO, for example.

Let me conclude by reiterating that the need for useful, relevant, informed, independent, objective, authoritative, and timely advice on the science and technology issues to the Congress is becoming more and more noticeable out here. There are certainly a variety of options for filling the various gaps, including the specific gap I mentioned today. We at the Academy look forward to playing a role in building those various options. I mentioned Will Rogers' advice earlier, but perhaps Yogi Berra's advice seems appropriate here concerning which path to take on improving and expanding the mechanisms for science and technology assessment and advice to the Congress: ``When you get to the road, and you have to--when you get to that fork in the road, and you have to choose, take it.' ' Since there are multiple paths that you can follow.

Mr. Chairman, thank you again for the opportunity to share my thoughts, and I look forward to answer any questions you may have.

[The prepared statement of Dr. Blair follows:]

Prepared Statement of Peter D. Blair

Mr. Chairman,

Thank you for the invitation to testify today about the science and technology advice to the Congress. The subject is certainly a longstanding one with me that I have seen from many perspectives--from academia, to private science and engineering consulting, to a senior management role in the former Office of Technology Assessment (OTA), to managing a professional scientific society, to my current post at the National Academies. I appreciate the opportunity to share those experiences and perspectives with you and the Committee.

The breathtaking pace of science and technology over the past half-century--from the remarkable advances in medicine, to cell phones, to the Internet, to countless others--has delivered both staggering benefits to society as well as sobering challenges associated with the

role of technology in virtually every aspect of our lives. Society, in reaping the benefits, must also be able to cope with the challenges.

Among the founding fathers' deepest concerns about the fledgling American democracy was that it could function well only when the electorate and, in particular, its institutions of government are well informed about the issues upon which it must decide.

James Madison or Thomas Jefferson might well have argued that a government poorly informed about science and technology issues, because such issues are often so complex and have such impact on society, is destined to make bad policy choices. Yet, today, it is becoming increasingly more difficult for anyone, or even any institution, to keep pace with the frontier of knowledge. How, then, can the Congress receive useful, relevant, informed, independent, authoritative and timely advice on the science and technology dimensions of the issues it faces? So your hearing today is important and timely.

Introduction

In the last decade the information revolution has dramatically expanded the quantity of information available to the Congress, but more information is certainly not necessarily better information. Indeed, a fundamental problem now is not really the lack of information; rather, it is how to gauge validity and usefulness within the flood of available information and advice.

Congress certainly has many possible resources at its disposal, ranging from universities, to independent think tanks, to existing Congressional agencies such as GAO, CBO, and CRS, and, of course, the National Academies. Other witnesses at this hearing will explore many of these options, so in my testimony I will focus on (1) the current and evolving role of the National Academies in providing advice to Congress, (2) what I consider to be an especially important gap in the current sources of advice for Congress, and (3) some thoughts related to a number of the options under consideration for filling this gap.

As an additional and more detailed discussion of some of these issues I would like to include for the record a report I prepared for a conference in Berlin earlier this year on precisely this topic: Scientific Advice for Policy in the United States: Lessons from the National Academies and the former Congressional Office of Technology Assessment.\1\

\1\ Forthcoming in Proceedings of the Symposium on Quality Control and Assurance in Scientific Advice to Policy, Working Group on ``Scientific Advice to Policy in Democracy,' ' Berlin-Brandenburg Academy of Science & Humanities, Berlin, Germany, January 12, 2006.

The Traditional Role of the National Academies

Today, among the most familiar sources of independent scientific and technical advice to Congress is the collection of organizations we now refer to as the National Academies, which include the National Academy of Sciences (NAS), the National Academy of Engineering (NAE), the Institute of Medicine (IOM), and their ``operating arm,' ' the National Research Council (NRC). In 1863 Congress chartered the NAS as an independent non-profit corporation to ``whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art.' ' This charter was signed by

President Lincoln during the height of the U.S. Civil War, and the President was among the first to call upon the Academy for advice.

Today, the NAS, NAE, and IOM are each honorary societies that elect new members to their ranks annually and all operate under the original NAS charter. The NRC assembles committees of academy members and other experts to carry out studies for executive branch agencies, but Congress also frequently mandates studies by the NRC spanning the entire spectrum of science and technology related issues. The NRC produces around 200 reports annually, of which approximately 25 are mandated by Congress.

The studies at the National Academies involve nearly 10,000 volunteers annually serving on expert committees and in the review process as well as over a 1,000 professional staff. In the science and technology advice world, the Academy is a substantial enterprise for providing advice to the Federal Government in a broad range of areas, although the role specifically for Congress has traditionally been a relatively small part of the overall Academy portfolio.

The key strengths of the NRC in providing advice to the Administration and to Congress are its long-established reputation for credibility, its convening power, and the integrity of its study process resulting in reports widely accepted as unbiased. Some features of these key strengths include the following:

<bullet> Credibility. Perhaps the principal strength of the NRC is its institutional credibility, enabled significantly by its association with the prestigious memberships of the NAS, NAE, and IOM. The process by which this nongovernmental institution conducts its work is designed to ensure the results are evidence-based and tightly reasoned, and its independence from outside influences and pressures from various interest groups including government agencies. It should also be noted that the Academies conduct several studies each year using our own endowment or foundation sources, often focusing on topics that the Academies believe to be important but that the government may not be willing or able to fund. Examples include the recent effort, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, and the 2002 study *Making the Nation Safer: The Role of Science and Technology in Countering Terrorism* as well as many others very well known to this committee.

<bullet> Convening Power. A second major strength is the convening power of the NRC. That is, the experts invited by the NRC to participate in its studies generally accept the invitation and are willing to invest considerable time and energy on a pro bono basis. Studies are carried out by groups of volunteers who are broadly considered among the best experts on the issues to be studied, are free of conflicts of interest, and have very carefully balanced biases. Because of the breadth of membership in the academies and the links of the organization to the scientific and technical communities worldwide, the NRC is well equipped to identify and recruit leading experts to serve on study committees.

<bullet> Study Process and Products. Finally, another key strength that has continued to evolve over the years is the NRC study process itself that is designed to maintain balance and

objectivity throughout a committee's work and that produces reports considered to be both unbiased and authoritative. A key quality control feature in the process is independent peer review. After consensus is achieved by a study committee and a draft report is prepared, the NRC process requires the committee to address all of the comments from a carefully selected collection of peer reviewers, whose identity is not revealed to the committee until the study is publicly released.

Challenges for Serving Congressional Needs

Over the years the NRC process has proved consistently to be a strong model for providing independent authoritative advice to government. Like any process designed to serve many needs, however, it is not perfectly tuned to serve all the needs of all parts of government that need science and technology advice. The most commonly cited issues associated with the NRC study process, especially perhaps as they relate to Congressional needs, are the following:

<bullet> Cost. It is often perceived to be expensive to commission an NRC study; even though committee members are volunteers whose time is contributed pro bono (except for travel expenses). At least in part this perception is due to the fact that a separate contract is negotiated for each individual study--unlike the central funding for agency advisory committees.

<bullet> Timeliness. The NRC process, which includes commissioning and contracting for the study, selecting and convening a study committee, arranging subsequent meetings among busy people who are serving on a volunteer basis, and navigating a report through peer review, editing, production, and release takes time. The average time for an NRC study is 18 months, but can be longer. It should also be noted, however, that studies can be carried out quite rapidly given an important national need or specific agency or Congressional requirements. As examples, both *Rising Above the Gathering Storm* and *Making the Nation Safer*, noted earlier, were completed in about six months and a widely cited study, *Climate Change Science*, was completed in one month.

<bullet> Sources of Sponsorship. Most NRC studies are commissioned and paid for by federal agencies through contracts, even those mandated by Congress which adds the additional hurdle of enacting a law. On the one hand, this is beneficial in that it helps ensure that what the NRC does is relevant and important, and the diversity of support helps assure independence. On the other hand, it often takes six to nine months through a government procurement process to initiate an NRC study even after a mandated study has been enacted in law (or included in report language). For those studies mandated by Congress, an additional delay often results from the time needed to enact the relevant legislation.

A Gap in Types of Advice Currently Available to Congress

The NRC study process is well developed and serves an important

need of Congress--an authoritative set of findings and recommendations from widely recognized experts, often leading to a specific recommended course of action. In particular, NRC committees are usually assembled with the intention of achieving consensus recommendations supported by evidence. In a very controversial subject area with scientific and other uncertainties, if a broad set of perspectives are included in the study committee, as one might expect if the purpose is to include all possible scientific and other perspectives on a problem, a consensus might be difficult to achieve. This is why the NRC places a high priority on an appropriately balanced committee and a rigorous information-gathering phase of a committee's work, where such perspectives are heard.

Since the historical focus of the NRC process has been on delivering consensus-based advice on science and technology topics, the process is less well equipped to elaborate on the broader context of an issue and inform the policy debate with careful and objective analysis of the policy consequences of alternative courses of action, especially those that may involve value judgments and trade-offs beyond the scope of technical analysis. Consequently, it has been far less common for the NRC to assemble committees charged with identifying and evaluating the pros and cons of a range of alternative policy options, although it would certainly be possible to develop such a study process in the National Academies.

Both types of analysis just described are important to congressional deliberation depending upon the circumstances. With the closure of the former Office of Technology Assessment (OTA), the latter type of analysis as performed by a disinterested analytical organization is no longer readily accessible to the Congress and may need to be reconstructed in some way, either through adapting an existing organization or through creation of an organization that is answerable directly to the Congress or perhaps creating a new process within an existing Congressional agency.

As an example illustrating the analysis gap just noted, consider the case where Congress may be interested in the future of the Nation's electric power system, following a major blackout. The salient issues could be posed in two alternative ways:

<bullet> One type of study would be to seek an authoritative set of recommendations for making the system more secure and reliable in the wake of blackouts or threats of terrorist attacks on the Nation's infrastructure. In such a study, the well established NRC approach would be to assemble a committee of experts, review what is known about the power system and where it is headed, and deliver specific engineering and operational recommendations about how to improve system reliability and performance. Indeed, we currently have such a study underway to assist the Department of Homeland Security.

<bullet> In another type of study, Congress might be interested in exploring the technical as well as societal, environmental, economic, regulatory, or other broad implications of alternative scenarios for the future of the Nation's electric utility industry, perhaps once again precipitated by a blackout. Not only technical, but also political, economic, social, environmental, and probably many other kinds of tradeoffs and value judgments are involved in characterizing a series of scenarios for the future structure

of the industry, ranging from moving toward a national centrally controlled grid to fully deregulating wholesale and retail electricity segments of the industry.

These two types of studies are not necessarily mutually exclusive, but unlike the first case, in the second case a set of consensus recommendations is not the principal objective, and the collection of stakeholders and experts necessary to carefully identify and explore these alternatives would be considerably different than for the study committee structured to reach an evidence-based, tightly reasoned consensus recommendations based on scientific evidence and on specific technical issues.

In short, and perhaps at the risk of being simplistic, the first type of analysis is designed to illuminate the scientific and technical aspects of a problem to help in directing a specific course of action while, in the second case, the analysis is designed principally to inform the Congressional debate, including perspectives that may go beyond science and technology about the broader implications of alternative actions related to the science and technology issues being considered, but both types of analysis are very important to Congressional deliberations.

Evolving Study Processes at the NRC

The fact that the NRC process does not now accommodate the second form of advice noted above does not mean that it could not; indeed, NRC processes to do change from time to time in response to government needs. As a case in point--the horrific terrorist events of September 11, 2001 spurred widespread interest in findings ways to contribute to the understanding of the science and technology dimensions of homeland security and countering terrorism. Specifically, many government agencies expressed urgent needs for immediate advice in these areas. In response, the NRC used its convening power to assemble small groups of experts who then provide advice as individuals, rather than as a group constituting an NRC committee. Such ``real-time'' advice, which is done orally and not by a written report, does not carry the imprimatur of the NRC study process, especially the quality control aspects of committee deliberation and peer review of a written report. It does, however, provide a new means of satisfying a real need of the government, i.e., providing timely input to policy makers and other organizations, including the Government Accountability Office (GAO) with whom we now have a longstanding relationship along these lines.

Additional Congressional needs vary widely, including such deliverables as (1) ``instant education'' on a complex science and technology issue, (2) ``translations'' of authoritative reports to more readable and understandable language tuned to the needs of broad policy-makers, (3) summaries of landmark authoritative reports, and (4) updates or adaptations of existing reports and information to current needs, and (5) readily available and trusted expert consultants on call to help with quick turnaround questions and interpretations of complex technical information. Some of these capabilities are accessible to varying degrees through the Congressional Research Service and through various other means. Missing, however, especially since the closure of OTA, is an ability to provide comprehensive analysis in any organized or readily accessible way by an organization directly accountable to Congress.

Collaboration and a GAO Experiment

In an experiment to test the feasibility of developing a ``technology assessment'' capability in the Government Accountability Office (GAO), a first-of-a-kind GAO technology assessment report on biometric technologies was released in 2002. The NRC did not participate in developing this assessment, but it did use its contacts to assist the GAO in identifying individuals with the proper expertise. There are some shortcomings in the approach adopted by the GAO in carrying out its first attempt at a technology assessment, most notably the lack of a substantive and accountable peer review process. Nevertheless, the experiment has been more successful than many anticipated and the GAO seems receptive to incorporating improvements suggested by a review group commissioned to review the GAO approach. In particular, the group identified a number of significant organizational challenges that it felt were necessary to refine the GAO approach, such as the incorporation of a mechanism for peer review, which could then possibly evolve into a more mature technology assessment capability within the legislative branch.

Whether the GAO is capable of such reforms on a larger scale remains to be seen, but it seems fair to conclude that the initial GAO experiment has yielded evidence sufficient to continue the experiment. We are pleased that the NRC's modest role in this experiment, by providing experts to talk with GAO, appears to have been one of the successful features of this approach and may constitute a way in which the National Academies can contribute to a renewed technology assessment capability within the legislative branch, in addition to its more traditional response to congressionally mandated requests for assistance. Such a mechanism provides the GAO a degree of access to the National Academies' considerable network of technical expertise. If needed, the Academies would also be willing to conduct similar studies commissioned by GAO to aid in responding to important Congressional requests.

The Former Office of Technology Assessment

By comparison with and in contrast to the NRC study process, the former Office of Technology Assessment (OTA) study process used an authoritative committee of volunteers as an advisory panel rather than assuming authorship of the study itself, which was produced by professional staff. As with NRC reports, OTA reports were also subject to a rigorous peer review. On the one hand, this approach permitted easier regulation of the role of the committee, particular if achieving a consensus in a broad controversial area was unlikely, but, on the other hand, such a practice also sacrificed the authoritativeness of the volunteer experts as authors of the report, an important feature of the NRC process.

Because the former OTA panels were advisory, and not the report's authors, the necessity of reaching a consensus was seldom an issue. Indeed, OTA was prohibited in its enabling legislation from making recommendations, so the panel was created to try to collect the views of all important stakeholders rather than to try to produce consensus recommendations (although consensus findings and conclusions were provided and viewed as important by requesting Congressional committees). Instead, the OTA project teams sought to analyze and articulate the consequences of alternative courses of action and elaborate on the context of a problem without coming to consensus

recommendations on a specific course of action, which would be difficult anyway with a diverse group with points of view that prevented consensus on many controversial issues.

If required to come to a consensus set of recommendations, even if it were permitted under the enabling legislation, the former OTA model would likely be unworkable for controversial subjects with many opposing points of view. Nonetheless, the type of study undertaken by the former OTA was an important input to Congressional deliberation and it has not yet been reproduced in the Legislative Branch agencies or elsewhere, including the National Academies. The Academies could carry out such studies but that would require some changes in its study procedures for such studies as indicated above.

Conclusions

The National Academies have enjoyed a longstanding and effective working relationship with Congress on even the most contentious issues. There are, no doubt, many characteristics of that relationship that could be improved, both to perform the traditional NRC role more effectively and to provide some opportunities to expand that role.

The gaps I mentioned earlier in the mechanisms for providing useful, relevant, informed, independent, authoritative and timely advice on the science and technology issues to the Congress are becoming more and more noticeable. There are certainly a variety of options for filling these gaps, some of which might involve the Academy and some that would not. Many of them are worthy of serious consideration and we in the National Academies look forward to playing a role in this very important area in whatever mechanism develops. Thank you again for the opportunity to share my thoughts with you today and I look forward to addressing any questions the Committee might have.

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Biography for Peter D. Blair

Peter Blair joined the National Research Council's (NRC) Division for Engineering and Physical Sciences as its first Executive Director in 2001, responsible for the NRC's portfolio in defense, energy and environmental systems, information and telecommunications, physics, astronomy, mathematics and operations research, aeronautics and space science and engineering, materials, manufacturing and engineering design, and civil engineering infrastructure.

Prior to his appointment at the NRC, from 1996-2001, Dr. Blair was Executive Director of Sigma Xi, the Scientific Research Society and publisher of American Scientist magazine, as well as an Adjunct Professor of Public Policy Analysis at the University of North Carolina at Chapel Hill.

From 1983-1996 Dr. Blair served in several capacities at the Congressional Office of Technology Assessment (OTA), concluding as Assistant Director of the agency and Director of the Industry, Commerce and International Security Division where he was responsible for the agency's research programs on energy, transportation, infrastructure, international security, space, industry, commerce, and telecommunications. He received the OTA's distinguished service award in 1991.

Prior to his government service, Dr. Blair served on the faculty of

the University of Pennsylvania with appointments in the graduate groups of energy management, regional science, and public policy and was a co-founder of Technecon, Inc., a Philadelphia engineering-economic consulting firm specializing in investment decision analysis of energy projects and in developing, financing, and managing independent power generation projects.

Dr. Blair holds a B.S. in engineering from Swarthmore College, an M.S.E. in systems engineering and M.S. and Ph.D. degrees in energy management and policy from the University of Pennsylvania. He is the author or co-author of three books and over a hundred technical articles in areas of electric power systems engineering, energy and environmental policy, computer modeling of energy systems, regional science and input-output analysis, and commercialization of new technology.

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Chairman Boehlert. And thank you for sharing the wisdom of one of the most beloved Yankees.

Dr. Hunt.

STATEMENT OF DR. CATHERINE T. HUNT, PRESIDENT-ELECT, AMERICAN CHEMICAL SOCIETY; LEADER FOR TECHNOLOGY PARTNERSHIPS, ROHM AND HAAS COMPANY

Dr. Hunt. Chairman Boehlert, Ranking Member Gordon, and distinguished Members of the Committee.

Good morning. My name is Dr. Catherine Hunt, and I am pleased to address you this morning on behalf of the more than 158,000 members of the American Chemical Society, the largest professional society in the world, or I should say, the largest scientific society in the world. I am the 2007 President of the Society, and I am also a technology manager at the Rohm and Haas Company, an \$8 billion specialty materials company, where I build and champion technology partnerships across industry, academia, and national labs.

In this age of lightning fast technological advancement, and potentially massive information overload, it is increasingly important that Congress have a reliable, credible, and unbiased source of scientific and technical advice to help sort through complex and often conflicting data.

Take this glass of water, for example. It looks perfectly clean and pure, but as an analytical chemist, I can tell you that there are trace chemicals and minerals in this water that we couldn't detect even five years ago. Today's analytical technologies can take us down to the part per quadrillion level. That is part per quadrillion. That would be one inch in the distance it would take you to travel to Mars round trip 168 times. So, are these substances bad or good? Should they be banned or enhanced? Any such decision should be based on sound technical assessment.

In essence, the flow of scientific and technical information to Congress from any source should be subject to critical measures. In other words, I would like to hear everyone say: Is this accurate? Is it complete? Is it current? And most importantly, is it reliable? To be useful, it is

critical, and you have heard this morning, that this information be available in a timely manner, and that it be easily used and understood by those with and also without extensive scientific and technological background.

Since ACS was founded in 1876, the effective dissemination of reliable information and advice has been one of the Society's central tenets. In fact, ACS was chartered by Congress in 1937 to share scientific knowledge with a broad constituency, including Congress and the executive branch.

Since the elimination of the Office of Technology Assessment in 1995, Members of Congress have had to rely more heavily on their personal staffs, and on the relatively small number of expert professional staff that populate committees like yours. Also since 1995, the ACS has hosted 109 Science & the Congress program briefings on Capitol Hill, seeking to present unbiased information on technical and public policy subjects. Congressional staff tell us that these briefings provide balance of views and information that is what I need to know and when I need to know it.

To meet its needs for S&T assessments, Congress clearly should continue to use outside experts, including the National Academies, to provide nonpartisan analysis of large scale, complex issues. However, these experts cannot meet all of Congress's frequent and extensive needs.

Congress does also tap into the expertise at the Congressional Research Services and the GAO, as you have already heard this morning. But again, these support agencies are not currently structured to perform all of the analysis required by legislators.

So, in summary, ACS, the American Chemical Society, believes that Congress should consider establishing an in-house science and technology unit, a properly structured unit, and what do I mean by properly? I think it should have several qualities. It should be bipartisan. It should be sufficiently staffed to furnish complete analyses. It should have strong links to outside experts, to facilitate collecting a broad selection of inputs, and it should be staffed with professionals who are especially skilled, and I can tell you these are skills I look for in my staff to do technology assessment at Rohm and Haas, that they can look at the pros and cons of an issue, that they can look at the strengths and weaknesses, that they can identify opportunities and threats. And refining this input that they collect broadly into potential policy options for Congressional use.

It should consider leveraging current science and technology fellowships that we have heard about this morning. These have been funded by outside groups. And sponsor new fellowships to supplement the standing capabilities. I think it should also consider using existing models. I like to learn from the past, and to learn from what works in other places, if it can work for you. Looking at openness and peer review, that is what allows the National Academies and think tanks and others to assemble world class science and technology reports.

So, in closing, a new science and technology unit should be equally effective in performing two sometimes contradictory functions. First, assembling world-class science and technology assessments, and second, providing information to Congress in a

form and manner that facilitates your making sound policy decisions.

So, with that, I would like to thank you for allowing me to come and present our views on this important topic, and I would be happy to answer any questions that you may have.

[The prepared statement of Dr. Hunt follows:]

Prepared Statement of Catherine T. Hunt

Chairman Boehlert, Ranking Member Gordon, and distinguished Members of the Committee:

Good Morning. My name is Dr. Catherine Hunt.

I am pleased to address you this morning on behalf of the more than 158,000 chemical professionals (chemists, engineers, educators and entrepreneurs) of the American Chemical Society (ACS), the largest scientific society in the world. I am the 2007 President of the Society and I'm also a technology manager with Rohm and Haas, an \$8 billion specialty materials company, where I manage technology partnerships with the public and private sectors.

Today's hearing explores how Congress receives and analyzes the scientific and technological information that it requires to evaluate legislation, and how those information-gathering processes might be improved. As technology increasingly drives our nation's economy, security, and quality of life, the list of policy issues that demand sound science and engineering understanding is rapidly expanding in size and complexity. Over the past month, the House has held hearings on topics ranging from energy to climate change, from cyber security to voting standards--all of which contain a strong element of science and that might have benefited from additional technological assessment. In fact, I don't believe that there is a Congressional Committee that does not in some manner deal with science and technology issues--even though it may not be obvious at first blush. For instance, if we consider water quality and supply, the Agriculture Committee is concerned about water conservation, the Energy and Commerce Committee has jurisdiction over drinking water, the Transportation Committee handles clean water, this committee has oversight of water-related research and the International Relations Committee needs to understand technologies that impact potable water resources in the Middle East.

Sometimes information received by these committees, though popularly accepted and reported as fact, ultimately turns out to be unreliable, or worse yet--false. I think we would all agree that legislative action taken on the basis of this type of information would be regrettable and potentially damaging. Sometimes public opinion can drive policy, but as important as public opinion and media reports are, we mustn't allow these to push a rush to judgment without a careful evaluation of the facts. This is where I think it becomes increasingly important that Congress have a reliable, credible and unbiased source for scientific and technical assessment to help it sort through complex and often conflicting data.

Take this glass of water as an example. It looks perfectly clean and pure--and it probably is. But given the new advances in chemical detection technology, I'd venture to say that we could find numerous trace chemicals and minerals in this glass that five years ago would have been impossible to detect. Today's analytical technology takes us down to the part per quadrillion level--a part per quadrillion is equal to one inch in the distance you must travel to make 168 roundtrips to

Mars. But would we, or should we, legislate an immediate ban on the materials found in this glass of water just because we could detect them? In this example, I would suggest that information about the presence of these substances in and of itself should not be the basis for legislating a ban on the material, but rather such a decision should be based on an assessment of what impact, or potential impact, might these materials have on the health of the drinker--if any.

It is well known that the demands and expectations on Congress continue to increase. Ease and reliability of electronic communications has resulted in Congress being bombarded on a daily basis with hundreds of thousands of e-mails, faxes, and phone calls from interest groups, trade associations, scientific societies, and interested citizens and constituents. This constant river of communication is sorted, categorized, and assimilated by Members of Congress and their staffs to identify that most valuable of treasures in Washington--reliable information.

Since its founding in 1876, ACS has viewed the effective dissemination of reliable information and advice as one of its central functions. In fact, ACS was chartered by Congress in 1937 to share scientific knowledge with a broad constituency, including the Congress and the Executive branch. In truth, sharing scientific information is fundamental to scientific and technical societies and associations. Collectively, they provide a direct source of information and analysis via testimony and letters, face-to-face meetings and consultations, formal and informal communications, and other types of interactions.

These organizations also organize educational and informational briefings for members and staff on a wide variety of science and technology issues. Since 1995, the ACS Science & the Congress program has hosted 109 briefings on Capitol Hill that seek to provide balanced and unbiased first-hand information from subject-matter experts on a wide range of technical and public policy subjects. The feedback we have received from these briefings, which are well attended, is that they provide a balance of views and an educational overview for congressional staff who are generally seeking such information on a just-in-time, tell-me-what-I-need-to-know basis.

Many other stakeholders in the legislative process utilize the same tools and seek to provide similar services, including think tanks, universities, federal agencies, trade associations, and companies. Most of these groups place great emphasis on their own credibility before Congress and thus strive to be regarded as honest brokers of reliable information. However, to some extent, most of these outside sources of information have a vested interest in the outcome of your deliberations.

The flow of scientific and technical information to Congress from any source should be subjected to critical measures: Is it accurate? Is it complete? It is current? And, most importantly, is it reliable? To be able to use this information, it is also important that it be available in a timely manner and in a way that it is easily used by those without backgrounds in science and technology.

To meet its need for science and technology assessments, Congress clearly should continue to use outside experts, including the National Academies, to scope, integrate, and provide non-partisan analysis of large-scale complex issues involving science and technology. However, these experts cannot meet all of Congress' frequent and extensive needs, and ACS believes that Congress should have greater access to assessments on a wider range of subjects than outside organizations are capable of providing.

Since the elimination of the Office of Technology Assessment in 1995, Congress has functioned without an impartial internal unit that can frame complex issues, provide comprehensive and balanced insights and analysis, and set out policy options on science and engineering issues. Members of Congress have had to rely more heavily on their personal staffs and on the relatively small number of expert professional staff that populate committees like yours to perform this critical function. Congress also taps the professional expertise at the Library of Congress Congressional Research Services (CRS) and the Government Accountability Office (GAO).

Many experts believe that these congressional support agencies are not currently structured and staffed to perform all of the in-depth, unbiased scientific and technical analyses required by legislators. Congress should consider establishing an in-house science and technology unit that supplements their capabilities and provides timely, thorough assessments for decisions on issues involving a wide range of science, engineering, and technology. This unit could be housed in CRS, GAO, or stand alone as a congressional support agency.

What would such a unit look like? A properly structured, in-house unit should have sufficient staff to furnish complete analyses. It also should rely significantly on outside experts to refine their input for congressional use. Its operations should be economical and efficient in order to provide a regular stream of timely advice to Congress. The new science and technology assessment unit might also consider leveraging current science and technology fellowships funded by outside groups, and sponsor new fellowships to supplement its standing capabilities. By placing scientists and engineers in various legislative offices and committees, the new unit would be more relevant and approachable to all congressional members and staff.

To be effective, a new science and technology assessment unit must be equally effective in two sometimes contradictory functions--(1) assembling world-class scientific and technology assessments and (2) providing information to Congress in a form and manner that facilitates your making policy decisions. In the former area, the unit should use the existing models, including openness and peer review, that allow the National Academies, academics, and think tanks to assemble world-class science and technology reports. While I am not an expert on the latter challenge, I would observe that you are in the best position to determine how the unit should be organized to most effectively operate in your unique environment and meet your needs.

Thank you for this opportunity to present our views on this important topic. I will be happy to answer any questions you may have.

Biography for Catherine T. Hunt

Education and Employment

Dr. Catherine ``Katie'' T. Hunt is Leader, Technology Partnerships for Rohm and Haas Company, where she builds collaborations between the company, academia, government agencies, and private foundations. Since creating the unit in 2002, she has helped secure multi-million dollar grants from federal agencies to improve collaboration across all sectors of the chemical enterprise. In 2002, Dr. Hunt acted as a member of the steering committee for the ``Nanomaterials and the Chemical Industry Roadmap Workshop,'' a collaborative effort between the Department of Energy Efficiency and Renewable Energy (DOE/EERE), the National Nanotechnology Initiative (NNI), and the Chemical Industry

Vision 2020 Technology Partnership. As a result of this workshop, Dr. Hunt co-authored the Chemical Industry R&D Roadmap for Nanomaterials by Design: From Fundamentals to Function.

Dr. Hunt began her career in industry with Rohm and Haas Company in 1984 after completing an NIH Postdoctoral Fellowship at Yale University. Since then, Dr. Hunt has held a variety of positions at every level of the company from Senior Scientist in Analytical Research (1984) to Philadelphia Plant Laboratory Manager (1991) to Director of Worldwide Analytical and Computational Competency Network and Technology Development (1998). She was named to her current position in 2002.

Dr. Hunt holds an A.B. in Chemistry (Cum Laude) from Smith College, Northampton, MA, and a Ph.D. in Chemistry from the University of California, Davis. She has authored 13 papers, one book chapter on Metallothionein.

Professional Organization Leadership

Dr. Hunt is the 2006 President-Elect for the American Chemical Society. She will serve as President in 2007 and as a member of the Board of Directors from 2006-2008. She has been a member of the society since 1977. She is also an active member of the American Association for the Advancement of Science, the International Union on Pure and Applied Chemistry, and Sigma Xi. Dr. Hunt serves on the Board of Directors of the Council for Chemistry Research and was a participant in the Vision 2020 Industry Group.

Over her professional career Dr. Hunt has received many awards including being a member of the Women in Science Delegation to Cuba (2001); Best Paper Award from INDA, Association of Nonwoven Fabrics Industry (1997); Rohm and Haas Company, S.J. Talucci Quality Award (1996); and NIH Postdoctoral Fellowship (1982-1984).

American Chemical Society

The American Chemical Society is a nonprofit, member-governed organization that consists of more than 159,000 individual members at all degree levels and in all fields of chemistry and chemical engineering. The organization provides a broad range of opportunities for peer interaction and career development, for a wide range of professional and scientific interests. As the world's largest scientific society and in keeping with its congressional charter, ACS advances the chemical enterprise, increases public understanding of chemistry, and brings its expertise to bear on state and national matters.

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Discussion

Chairman Boehlert. Thank you very much, Dr. Hunt. And let the Chair note for the record that the glass Dr. Hunt used in her illustration is half full.

You know, Dr. Blair gave an example of the kind of study that he thinks Congress is not getting, and although he noted that the Academy might be able to fill the gap. Could the rest of you on the panel describe a kind of study, a specific example, that Congress doesn't receive now, because we lack a

mechanism to do so, and then, could you tell me what you think would be the preferred mechanism to get the information to Congress?

That is a tough question. Who wants to go first? Dr. Peha?

Dr. Peha. Well, one issue I have been following, both inspired and horrified by 9/11, is communication systems for first responders, firefighters, police, National Guard. There have been hearings on this topic in a variety of committees, on both the House and Senate side, where I have seen people come in and say here is the little piece of the problem that I see, and here is the incremental change that would help me deal with it. And that is great, but that doesn't allow you to look at the whole problem, and one of the reasons we are in the mess we are in is because the problem has been fragmented so many ways, with each organization looking at its little piece. And another problem is that sometimes, incremental change isn't the way to go, and----

Chairman Boehlert. How would you address that particular one?

Dr. Peha. I think--I mean, a study that came in and said here are a variety of options, and some of them are incremental, and some of them are, you know, some of them are to do nothing, some of them are to beef up this and to beef up that. Others are to look at more fundamental kinds of change. In this case, I in particular think that we have to stop looking at municipally-led systems, tens of thousands of them, and start looking at broad regional and national systems.

And to study the technical, economic, organizational impact, you would need some other kind of organization to look at something that broad, and to compare it to the other incremental approaches.

Chairman Boehlert. Well, would the Academy be able to fill that gap, or would you create a new vehicle, and----

Dr. Peha. I think the--I mean, the Academy has also looked at parts of this. They also, because, you know--Peter and I were talking about this exactly before, they have to bring together people who will come to consensus, and they have been looking at all the neat little technologies that they could use incrementally to advance what people are doing. But to look at something radically different, it is very difficult for the Academy to do.

And you know, you could look at something radically different and say it is the wrong idea, but to come along and say here is a very different choice. Here is what would happen if the Department of Homeland Security took the lead, instead of city governments. That would have to come from somewhere else.

Chairman Boehlert. Do you have an idea where that somewhere might be?

Dr. Peha. Well----

Chairman Boehlert. Should we resurrect OTA, for example? Did that pass your four----

Dr. Peha. Yeah. At the moment, frankly, Carnegie Mellon University is trying to look at this, but we are too far removed. I would like to see some organization that answers directly to Congress, that is--has staff that are, you know, that answer only to Congress. They may do some of the work

themselves. They may farm it out to--pieces of it out to consultants, as Congressman Rohrabacher suggested, but ultimately, they would put those pieces together. They would negotiate with Congress what they are supposed to do, and they would present it to Congress when they are done.

Chairman Boehlert. Thanks. Dr. Teich, do you have an observation you would share with us?

Dr. Teich. Well, I can--I could say what he said, that I like, but I think--pick a different area, pick energy conservation, for example. That is an area in which there are a huge number of existing studies. There are a wide range of views on how to accomplish it, but we are very far from having a systems point of view on that, and of implementing programs on a sufficient scale to accomplish what we need to accomplish, I think.

So, what Congress needs is some kind of mechanism that will synthesize the knowledge, and will give it ownership of a set of ideas that will satisfy the diverse needs that conflict in this--in that kind of an arena, the various companies that have a vested interest, the other organizations. And to take the scientific data out of all that, and put it in a framework that Congress can look at and can use.

Chairman Boehlert. With all due respect, in that particular example you are using, energy conservation, we are not short on getting good science up here. We just don't want to accept it. We ignore it.

Dr. Teich. Well, I am----

Chairman Boehlert. You know, we like to say we are for scientific consensus, until the scientific consensus leads to a politically inconvenient conclusion. Then we want to go to Plan B.

Dr. Teich. Right.

Chairman Boehlert. The sciences--for example, one of my pet causes, CAFE standards. We have got off the shelf technology, don't have to launch a new research program, off the shelf technology that could be employed that would save us, you know, millions of barrels of oil at a time when we are so dependent on foreign source oil. Pretty logical, but you have people questioning the science. Not--scientists questioning the science, you have policy-makers, so the problem, the frustration I have is that you can lead a horse to water, but you can't make him drink sort of thing. And we have got the good science there, in this area particularly, and we ignore it, because it is not politically convenient to address the good science in a meaningful way. But----

Dr. Teich. I guess that was the point I was trying to make, and perhaps not as well as I would have liked, but Congress needs an institution that will help it to drink in this case.

Chairman Boehlert. Well, but once again, you get--the institution, whether it is a reconstituted OTA or any other sort of think tank, objective, impartial, independent, adequately funded. You can have, you know, hordes of people with--spending tens of millions of dollars, but when they present something to Congress, Congress has to make policy decisions, and not science decisions. All the science is there to prove the point, but so many people ignore it, unfortunately.

Dr. Blair, you are going to answer your own question?

Dr. Blair. Yeah, if you don't mind.

Chairman Boehlert. Well, that is fine.

Dr. Blair. I would like to offer an example that may illustrate the gap I described. I mentioned in my written testimony, but I didn't describe in detail, I think, an example of the kind of gap I am talking about.

Out in California right now, we are in the middle of rolling blackouts in some parts of the electric power system, and there is a lot going on in the electric power industry right now, and where the future is headed.

We at the Academies are very well suited to look at, for example, producing an authoritative set of recommendations for making the power system more secure and reliable in the wake of blackouts and the threat of terrorist attacks. In fact, we are doing that study right now for the Department of Homeland Security. However, we are not looking at, for example, a way in which the electric power system might evolve over the next decade with the pressures of increasing competition, how it has worked or not worked in different parts of the country, how the role of technology is affecting our ability to install new generation in different parts of the country, the social, economic, political, and other dimensions where it is almost impossible to achieve a consensus, but it is important for Congress to have the context of those issues laid out in a way that helps inform the debate, in a realistic way, which is very important.

Chairman Boehlert. What would you suggest--what would be the vehicle to carry that forward?

Dr. Blair. Well, I laid out a few of the options in the--in my testimony, that I suppose the Academies could evolve in that direction. We are currently not now constituted to do that very well, because as Al mentioned, we are designed to come to scientific consensus on committees, come up with consensus findings and recommendations. That would be almost impossible in this kind of an argument.

So, having a body that could do this, directly tuned to the needs of Congress, is important. It could happen in a variety of ways, anywhere from resurrecting the function that was provided by the former Office of Technology Assessment, to perhaps modifications in some of the existing Congressional agencies, to perhaps even adapting some mechanisms outside the Congress, but directly reportable in Congress.

Chairman Boehlert. I have far exceeded my time, but Dr. Hunt, do you have something special you would like to offer?

Dr. Hunt. What I would say is, the way I like to approach this in industry is to put out a grand challenge, or in any case, something where you look and say, how could that possibly happen? Like, let us cut gas prices by a factor of ten, or a factor of a hundred, or let us just go non-petroleum. What would it take to do that?

And the reason you start with something like that is it makes you think out of the box. It makes you come up with solutions you might not be able to come up with looking at standard reports. And where I would say this would take you would be to look at energy policy, right. If we had an energy policy that looked at short-term, long-term, mid-term types of

capabilities, and I think there are a lot of reports out there, as you have said, there is a lot of information. How do you assimilate that together and put forward an energy policy that will truly decrease our dependence on foreign oil?

And it takes what we call at work institutional fortitude, right, there are things and--that are not politically acceptable, but the question is, can we focus with the end in mind, and develop a place where there is an independent body that can provide choices.

Chairman Boehlert. Thank you very much. I apologize to my colleagues. I went way over my time limit.

Mr. Gordon.

Mr. Gordon. Thank you, Mr. Chairman. It was a good area of inquiry.

I am one that thinks that Congress needs additional nonpartisan, independent scientific information. I think it will help us make better decisions, and I think it will help us use the taxpayer's dollars more wisely. And so, let us--I want to get more specific than sort of the wide-ranging discussion we have had so far.

There are some that think that after the November elections, that the Congressional horse might be more willing to drink, and if that occurs, then let us again be more specific. One approach would be, OTA is already authorized. It is just not funded. And so, my question would be what are the pros and cons of properly funding and staffing OTA to accomplish the goals that we had been talking earlier, and I will let each witness try to succinctly give us an opinion on that.

And why don't we do it in reverse order this time.

Dr. Hunt. So, I think--sometimes, I think that it is important to change the name of something, so that indeed, you don't go back to what you had before, but that you look at what the qualities are that you want in the future.

And I think that you heard a lot of summary of that here this morning that I think you would want to go back to. It needs to be bipartisan. What you are----

Mr. Gordon. Yeah, but I--my sincere question is----

Dr. Hunt. Okay.

Mr. Gordon.--is what are the pros and cons of appropriately funding OTA? It is already authorized. What are the pros and cons of doing OTA?

Dr. Hunt. Okay. I would say one of the pros is, it would be expeditious, okay. It would be something you could do and put in place quickly. What I think one of the cons would be is that you would want to make sure you construct it, not just revive it as it was, but construct it to address any issues you felt that were not appropriate, or not satisfactory.

So, if timeliness is important, you need a process that will direct timeliness. If choice of projects is important--am I going down the road you----

Mr. Gordon. Not really, but we will go to Dr. Blair.

Dr. Hunt. Okay.

Mr. Gordon. Let us see if he can get down there.

Dr. Blair. Well, this may be context, but I have either the distinction or the misfortune of being the one who literally turned the lights out at OTA, and handed the keys over to the

Architect of the Capitol, and I think that, as I think back, at the time of OTA's closing, and what OTA would look like now, I think it would be a very different place.

A lot has happened in those 10 years. The way in which people communicate with Congress, the day-to-day operations, perhaps the--at the time OTA was closed, the ability to react more nimbly, to provide interim results to major assessments, to interact more with the broad individual membership of Congress, in addition to the committees. All of these are things that were sort of on the table at the time, but in the flurry of the decade ago, didn't have time to mature.

So, on one hand, yes, the pros are that the function exists. It could be started up again, but I think it would have to be a different place. The function is quite clear, and I think OTA could do it. Perhaps some of the other experiments that are going on, such as the enhancement of the GAO technology assessment experiment, or perhaps, the idea of building a function like this within the Congressional Research Service. But there are cultural changes that would be necessary there in order to really appeal to this function we have been talking about.

Mr. Gordon. Well, you are starting from scratch.

Dr. Blair. Yes.

Mr. Gordon. So, it is not a matter of having, I don't think, those liabilities.

Dr. Blair. Right.

Mr. Gordon. In terms of updating it, you can trade in your manual typewriters for computers, and you can also recognize you are dealing in a different age.

Let us see, Dr. Teich.

Dr. Teich. Well, I think the pro is obvious, and has been identified by my colleagues, which is that it would be the easiest route legislatively, since you would not need to pass new authorizing legislation to establish it.

I think one of the cons is the legacy of--which may not be such a major consideration at this point, since I think many of the people who were involved in the decision on OTA are no longer in the Congress, and a lot of others have, perhaps, forgotten that the issue existed. But I think that is also one of the problems, which is--that needs to be addressed in creating a new function, and I don't know what you call it, and I don't have a formula for establishing it, but too many people in the Congress, too many Members, I think, didn't really care. It wasn't that important to them. It didn't serve them sufficiently, and I think that somehow, a new function has to be created that would serve the Congress more broadly than OTA did.

OTA tried. It didn't have the resources, I think. It never established the kind of presence in the Congress that made it indispensable. It needs to have that kind of presence. It needs to have a connection to a wide range of committees, and to a wide range of Members.

Mr. Gordon. I think to some extent, it was the victim of a drive-by shooting in '95. There was an interest to take a scalp, and it was a handy scalp. Do you want to finish up, and then we will move on?

Dr. Peha. I agree with everything that is said. If it would

be easy, and if that method is used of creating an organization, it would have to be understood that it is not reviving OTA. It is creating a new organization in that shell, that would look different, and learning the lessons of OTA.

But let me put this in the context of the alternative. The alternative is to create this function, or to establish this functionality in an existing organization, like GAO, Library of Congress, or CBO. That has advantages, in that you can share resources, particularly if you are establishing something that is initially not all that large, as large as OTA was in the earlier days. Establishing something in a new organization would have the disadvantage that you have a dissimilar existing mission, and you would have to protect the new activity from the old, it would, you know, it would have to have different processes. It would have to have staff with different skills, and you would have to make sure that there was sufficient independence in this new piece.

Or one other option, you create a standalone agency that looks, that, you know, with new authorization, that is whatever the new thing is.

Mr. Gordon. Okay. Thank you, and let me just suggest to all of the think tank folks, you know, that are here. This would be a good area to be thinking about. And that, I think, at least this committee would welcome recommendations, thoughtful papers, on how to set this operation up.

Thank you.

Chairman Boehlert. Thank you very much. The ever patient and always persistent Mr. Rohrabacher.

Mr. Rohrabacher. Thank you very much.

This is one drive-by shooter to the other. Let me note, there is some, you know, although we do recognize that drive-by shooters are bad people, but some people need shooting, you know. I will just have to tell you this, and frankly, when we were trying to get control of Federal spending, this Office jumped out at us as something that needed our attention, it needed to be put in our sights.

I--let me put it this way. What I hear today is the assumption that having something like the OTA reestablished is going to be--it is going to be an objective organization, and it has got to be, you know, all of these great words that are coming up to describe another layer of bureaucracy, and a buffer between us and the scientific world. You are assuming that this is going to be a very positive element, that now we put in place. I don't know what makes you--is there any scientific reason to assume that putting in this new layer of government between us and the scientific community will yield positive things? I don't think so. I mean, every time I have heard about hiring new government employees, and putting--and letting them be your, you know, one who is going to put it all together and describe to us what is good and what is bad, it has turned out bad.

Let me just note that what we need is not an organization that will serve as a conduit for which everybody has to come to us through. We need competing sources of information. That is what we need, and unfortunately, at some of our own hearings, we don't have both sides. I mean, I think the most important thing that we can do is have people in the scientific community

representing both sides of any issue, here, debating it in front of us, and recognizing that no matter how many people speak about what their authority is, there is disagreement among people even in the scientific community about which direction to go on certain issues, on most issues, I might add.

I remember when cyclamates, when I was a kid--Remember cyclamates?--were banned. By the way, they were never banned in Canada, let me note that. But we banned them, and we had terrific scientific information, the entire scientific community eliminated the billions of dollars that our soft drink companies had invested in cyclamates, and we eliminated them, and of course, 15 years later, we found out no, well, we were wrong. Sorry. Cyclamates really don't cause the cancer we thought they would, and of course, in the meantime, we got an obesity problem springing from soft drinks that are being consumed by people without cyclamates. So, anyway, there are-- what we needed to hear perhaps, back then, was a competing view on cyclamates, rather than just having one scientific buffer between us.

Finally, let me note, Mr. Chairman, the fellowship programs that have been mentioned today, the AAAS fellowship program, I would like to commend the AAAS, and I would like to make sure that we all know that there are wonderful, wonderful sources for Congress right now that I take advantage of. I have had a AAAS Fellow with my office for the last 15 years, and they have all been superior. They have really contributed greatly to my effectiveness and my efficiency and my understanding of various issues, as well as broadening the amount of sources of information that I have.

These are the ways that we should go. We should be encouraging universities and people to be available to us on a contractual basis, and fast turnaround, rather than well, we will tell you in ten years turnaround. Let us hear an assessment, and have someone who can go through the scientific assessment of what has already been researched, and get back to us with a report in two months, rather than two years. These are the type of things we need. We certainly don't need another buffer between us and the scientific community.

And with that, I would just--anything you would like to disagree with, or say you agree with, go right ahead.

Dr. Peha. I would agree that you don't need a buffer between Congress and the scientific community, and that, I think, is the last thing this organization ought to do. If you want to go out and reach out to----

Mr. Rohrabacher. Even though it may evolve into that.

Dr. Peha. This should simply be another information source, a more objective information source than many that you will get that will help you reach out to those other sources.

Dr. Teich. Yeah, I would--first of all, I want to thank you for your vote of confidence in the fellows program, both the things that you said, Mr. Rohrabacher, as well as----

Mr. Rohrabacher. Well, thank you. We thank you.

Dr. Teich. Well----

Mr. Rohrabacher. You have done a terrific job.

Dr. Teich. We--it is a two way street. We benefit from the ability to assist you, I think, and we are pleased that you are appreciative of the assistance that we have provided, as Mr.

Boehlert said, the--some of the--many of the Fellows go back to their careers in their universities and other institutions, and serve as points of contact between the policy-makers and the scientific community, and I think it is a very valuable thing to see happening.

And I think that same kind of thing can be created, if it is done right in an institution, such as the one we have been talking about, and I am not talking about reestablishing an OTA, but I am suggesting that some kind of institution does not have to be a buffer or layer or an insulating mechanism. It can be a semi-permeable membrane, if you want to use a scientific analogy. It can be something which transmits information in both directions, and that is the thing, that is the kind of thing I would like to see.

I would add that I think we have plenty of competing sources of information, and I think that is part of the problem.

Dr. Blair. Let me give you a California example. It is a buyer's market for houses in California right now. As a metaphor, if you are a buyer coming to look at houses, you can rely on the advice of the realtor, or his friends next door, or many others, but if they really would like to have an objective, independent view, they hire a house inspector to look at the quality of all of the--to be able to dig in the muck and see all of the things that are going on in that house before they buy it.

What you need is a house inspector. You need an organization that can provide this sorting out of all the conflicting pieces of advice, and do it in a way that is trusted to you, to you Members of Congress. And that is my California metaphor.

Dr. Hunt. So, I guess my industrial metaphor would be that when you have something important to do, and in this technology-driven society, I would say technology assessments would be what we would call mission critical, and that would be something that you don't outsource, your mission critical work. You certainly collect outside information, but you have that house inspector that is chartered to get you that information, to synthesize that information, and to present you with the options in the way that you can trust.

Chairman Boehlert. Thank you very much, and thank the gentleman. Ms. Matsui.

Ms. Matsui. Thank you, Mr. Chairman, and I want to thank the panel for being here today.

I have only been on the Committee for about three months, so I am one of those who can look at it as a newcomer, in essence. And I wasn't here 10 years ago at the demise of OTA, but as you have also said, a lot has happened in ten years, and I think one of you indicated that Members, perhaps, then didn't care about the area of OTA.

Today, however, as I think every single one of you has said, science and technology affects every part of our lives. We brought up last week stem cells, climate, energy. Everything is involved in this, so it is not just relegated in a sense, as being a part of just the Science Committee. So, every committee in Congress can benefit by whatever entity we are talking about here. I also believe that we have a lot of information, almost

too much information. Ten years ago, we were barely using email, and today, they are just blasting us all the time. We thought we had problems with fax machines, but that was nothing compared to email today.

And honestly, every single one of us probably has some sort of a personal scientific type of question, whether it be medical or whatever, and usually, the first thing you do is go to the Internet to try to figure it out, and you realize oh, boy, this is not the way to do it. And I think to a certain degree, for all of us here, we would like to be able to manage the information in a way which is independent, accurate, and timely, and I think all those things have to be factored in. I even believe that my very committed and very passionate California colleague would also like to see that, too.

We are all so very busy, and if it would be great for all of us, every single one of us in our districts have--we are from California, obviously, here. We have an energy crisis. We know that. It is 109 in Sacramento, and it is too hot, and gases are too expensive, and all that. So, science touches us everywhere. So, every single one of us has a need for some information, and we just can't go to the Internet. We can't just kind of look into the books, or go to the Academies. That is too much information. So, we need something of the caliber that we are trying to figure out here.

Now, is it possible, as we are talking about, to restructure this OTA, rename it, and come up with a different type of--the same mission, but perhaps more relevant to today. Because my feeling is, is that you brought up net neutrality. I mean, those of us here, I have a little bit of knowledge of it, but I didn't think that it was what was portrayed, and either, you know, you see the advertisements or hear it, and it is not quite what I thought it was going to be.

So, therefore, there is a real need, but it is a need, as my colleague says, this needs to be information that has to be given to us very quickly, and most of the time, we hear from the people who come to see us with their particular advocacies.

So, I am trying to figure out, is there a way to do this, so that we have adequate, accurate information. Maybe there is a system set up where there are hot issues that you can deal with, and other types of issues that are more lengthy and study. Can we do that in a manner which can address some of the concerns that Mr. Rohrabacher has, and that I would have, as far as independent, accurate information? I like to hear debates, but you know, you can get tired after a while, and you don't come back with that much information. I would like to have somebody give me good information.

So, each of you, could you respond to that?

Dr. Teich. Well, I think you have identified the problem very succinctly, and I would answer in response to your basic question that yes, it is possible to do this. I don't think we are going to decide exactly how right here and right now, but I think what is necessary initially is a recognition, and a recognition among a majority of Members, that it is necessary to have this kind of function.

And then, I think the kind of information that you need that will help you establish this in an effective way can be generated through additional hearings, through staff studies,

through outside contributions, but a variety, there are a variety of mechanisms that will assist you in developing this. But first of all, you need to recognize that it needs to be done.

Dr. Blair. In thinking back ten years ago, as I mentioned earlier, the centralized organization in the Congress would probably be a very different place now. But one of the things that struck me at that time, and even now, perhaps more, even more current, is an ability to collaborate among the Congressional support agencies. For example, CRS is very good at the off-the-shelf kind of analysis, the ability to give you the very quick answer. The former OTA was designed for the comprehensive, large scale assessments. There is a lot of room in between those two extremes. And is there an ability to network the organizations in the Congress, like the General Accounting Office, the Congressional Budget Office, CRS, and perhaps a new function that resembles the function of the old OTA, to provide a whole that is more than just the sum of the parts, to be able to react to that network of activities?

And actually in my paper, I talk a little about some of the experiments that are going on now. For example, the GAO experiment, where partnering with outside organizations, as well, for example, the Academies now have a relationship with the Government Accountability Office, to use our Rolodex to get experts to come in and convene and provide meetings of experts, to help inform GAO investigations. So, an ability to combine the strengths of multiple organizations has benefit, I think, for having a whole that is greater than just the sum of the parts.

Chairman Boehlert. Thank you very much. The gentlelady's time has expired.

Dr. Bartlett.

Mr. Bartlett. Thank you very much.

For the past 18 months or so, I have been involved in a dialogue on energy in this country, and a lot of people are now engaged in that dialogue, a lot of very bright people, and sometimes, equally ignorant people are engaged in that dialogue.

And we have a number of questions of fact for which we need answers, and I have two questions to ask you, and I will mention a few of those. I would like to know are these the kind of things that we could reasonably expect an OTA-like organization to give us answers to? And after that, where should we go now?

One of these is the amount of fissionable, the uranium that remains in the world. If we are going to move to light water reactors, how much fissionable uranium remains in the world? I get widely divergent answers to this, like 15 years and 100 years. Where are we?

The energy profit ratio of ethanol. Some believe that more fossil fuel energy goes into producing ethanol than we get out of ethanol. Clearly, if we are going to have a debate on where we go, we need to have an answer to this. To whom do we turn for that answer?

If there is a positive energy profit ratio for ethanol, is it reasonable that we could displace a meaningful amount of our gasoline with ethanol? Brazil now has no foreign oil imports.

Of course, Brazil is not the United States. They get their ethanol from sugar cane, which they grow largely with hand labor, and they don't have very many cars and so forth.

If it is true, as I am told, that 13 percent of our corn could displace two percent of our gasoline, and if you had to grow corn using the energy from corn, with a reasonable energy profit ratio, if we doubled our corn crop, one calculation says you would have to double our corn crop and use it all for ethanol, just to displace 10 percent of our gasoline--of how much of our biomass can we rob from our topsoil, and still have topsoil? What is the potential? To whom should we go for an answer?

USGS is using what I think is an interesting, if not bizarre use of statistics, where they take the 50 percent probability, and call it the mean, and using that, they project that we will find as much more oil in the world as all the oil that now remains in the world. Professor LaPierre says that that is just implausible. That just can't happen. But our Energy Information Administration uses this bizarre use of statistics by USGS to tell us that--not to worry about energy, because it just goes up and up into the wild blue yonder, and they--for the foreseeable future, they have energy going up and up when oil is \$75 a barrel today.

How much energy goes into producing the oil from the tar sands in Alberta? I am told that they may use more energy from natural gas than they get out of the tar sands. Okay, from a dollar profit ratio, the gas is stranded, but at the end of the day, that may be really dumb use of that energy in that gas. We had an experiment by Shell Oil Company in getting oil out of our oil shales in the West. They freeze a big vessel, then they cook it inside that for a year or so, and then, they pump for a year or so. What is the energy profit ratio there? And I have a lot of trouble believing that it is really a positive energy profit ratio.

And then, another consideration. Maybe we will move to nuclear. You build a nuclear power plant, it takes a lot of fossil fuel energy. For how many years do you have to operate the nuclear power plant before you get any net energy out of it? How many years do you operate it before you get back the energy you put into building the plant?

Now, are these the kinds of questions that an OTA type of organization could answer for us, and absent that, where can we go now for answers to these questions, because we can't have a reasonable dialogue until we agree on these facts, and there is no agreement.

Chairman Boehlert. Now, there is a test. Who wants to go first?

Dr. Blair. Well, I can take a crack at some of that. I think many of the dimensions of what you cite--in fact, let me say that my staff, our staff at the Academies, who have been talking with you, Mr. Bartlett, about energy problems, have been very inspired by a lot of the discussions they have had with you. And I think that many of the issues you describe are issues where a consensus group of experts from, say, the Academies could provide important insights onto questions of, let us say, fact.

But some of them that you described are moving in the

direction of choices, and issues that would require tradeoffs in understanding and the like, and it would be more difficult, as I think I mentioned earlier, for the Academies to come to consensus on those kinds of tradeoffs.

For example, one of the energy issues you didn't mention was--well, you did, sort of--on fuel economy of automobiles and gasoline, and there are dimensions of that where, you know, you might raise the issue of whether or not--how far off are plug-in hybrids, or how quickly can the auto industry turn over its fleet to a new generation of vehicles. We can certainly identify the technical potential, but identifying the policy tradeoffs, and how to get there, whether you adopt CAFE standards or fuel taxes, or all kinds of other policy mechanisms--

Mr. Bartlett. Yeah, both of those, thank you.

Dr. Blair. --those are much more subjective and policy rich discussions, but they are very complicated, and very intimately related to the technology. So, many of the issues you described, where the debate hinges on the interface between policy and technology are more in this, the kind of organization we have been talking about.

If you would like to talk specifically about cellulosic ethanol versus grain-based ethanol, and switchgrass, and all of that, I would be happy to do that with you at some point, but there is plenty of room in there for both approaches that we have been talking about.

Chairman Boehlert. Thank you very much. The gentleman's time has expired.

Mr. Green.

Mr. Green. Thank you, Mr. Chairman, and I thank you and the Ranking Member for hosting this most valuable hearing.

I would like to share a brief vignette that is not true, before I make my inquiry. The story is told of a person who receives information from messengers, and he tells the messengers: ``I want your most truthful, your most honest, your unbiased opinion.'' And the first messenger gives an opinion, and the recipient immediately shoots him. Then he says to the next messenger: ``I want your most honest, your most truthful, and your most unbiased opinion.'' The next messenger says ``I agree with you.'' And he says ``But how can you agree with me? You haven't heard my opinion.'' And the messenger says ``I don't need to know your opinion to know that I agree with you.''

Now, here is my question. What impact does closing an agency have on the opinions of those that remain behind? When we shut down one agency that gives us information, we have others that take up the task. Are they impacted by the knowledge that we can cease to fund you, and you will cease to exist? Does that color, in any way, the opinions of those left behind? And I am asking this in a sort of rhetorical sense, I guess, because we really are dealing with a question here of how do we have, or give those experts, a comfort level such that they can truthfully give honest opinions, and not assume that there may be some consequences associated with those opinions that may not be entirely positive?

How do we structure the process, the agency and the process, the methodology by which we acquire the intelligence,

such that we get--that what we are seeking, because people understand that they will still be around after they give us opinions that we don't necessarily like?

Anyone want to comment on that? We have--yes. Thank you.

Dr. Hunt. Well, I think any--we learn at an early age that actions speak louder than words, and that if you do something, and there are negative consequences, we learn to modify those behaviors, or sometimes, even restrict those responses.

Now, what you find in some of the best scientists, however, are those people that stick to their guns and have the courage of their convictions, because they truly believe in reporting the science or the data, or the information that they collect as they see it. And I think what we have to do is, we have to do two things. We have to continue to work with those scientists, and we also have to continue to have open minds about information, even when we get it, when it isn't what we want to hear, right.

And so there is really, those are the soft side of relationship skills that this--that we have to work with. One other place we look at that is with funding of science and technology, and if you look at funding going away from the physical sciences, it is difficult to bring students into that realm. But you can also look at that as your opportunity, because if you know that putting the funding there brings the students there, then you know how to make that change. And I am not saying that throwing money at something is the way to make that change, but as you said, by being consistent with your actions, and having your actions follow your words is, I think, the solution to that.

Mr. Green. Yes, sir.

Dr. Peha. This clearly is a problem. Actually, I mentioned a couple of things in my testimony I will expand on. First of all, I think Congress always has to have the ability to defund something that isn't working, but if it takes them a while, then any one particular study that, you know, they won't get shot on the first answer. It will take multiple answers, and one way to do that is to make staff decisions, budget decisions, hiring decisions not annual but longer term than that.

And that still doesn't help if there is a systematic problem, if the organization is always hitting the same group of powerful people who are unhappy. I think if that is happening, it may be that there is a real problem with the organization, or it may be, very likely, a problem with the choices of topics they are looking at, which is why the Congressional oversight is so important, the method of oversight, and particularly, the method of choosing which studies to conduct has to be done in a way that majority and minority and everyone in Congress feels that their issues are being represented, maybe not in every report, but overall, in the long term.

Mr. Green. Mr. Chairman, I yield back. Thank you.

Chairman Boehlert. Thank you so much. Mr. Holt.

Mr. Holt. Thank you, Mr. Chairman. As a guest here on the dais, I think I would like to allow all of the Members of the Committee to ask questions if they want, before I take my time.

Chairman Boehlert. How gallant of you. Ms. Jackson Lee.

Ms. Jackson Lee. Mr. Chairman, that will allow me just to be able to thank Mr. Holt for his enormous leadership on this issue, and to thank you, Mr. Chairman, and Mr. Ehlens for your valiant effort back in 1995. I was a baby Congressperson, and on this Science Committee, and obviously, now can look back and see the enormous damage that has occurred with the elimination of the OTA.

Dr. Blair, I am going to start with you, as I reminisce about other agencies, such as the GAO, the Congressional Budget Office, and Congressional Research Service. All of them are poised as effective tools to make Congress the real implementator of the will of the people, a knowledge implementator of the will of the people, meaning that as we address questions, fiscal responsibility, understanding the nuances of space exploration, or the nuances of homeland security, or again, trying to make sure that we handle the people's dollars effectively, that we have the arm of research.

Here we are now with an authorized, as I am informed, OTA, but a nonfunded OTA, and in the 11 years since 1995, the world has simply changed. It has changed after 9/11. It has changed as we have a raging debate on immigration, and the issue is technology, technology, technology. And therefore, our guidepost is missing. We just heard Dr. Bartlett speak eloquently about energy, and coming from the oil capital of the world, I am not afraid of the discussion on alternative fuels, because the companies were wise enough to change their name some years ago, they are energy companies. And I have tried to convince them that they will be as prosperous no matter what energy science we attempt to use.

Someone who has had firsthand experience, I believe, with the OTA, and maybe others would comment as well. How much are we diminished because we don't have a corralling entity that can assess, as Congressman Daddario, I think, in his original vision, when former--well, when Mr. Lindbergh came and began to talk about the Earth and ecology, and wanted to be concerned about someone assessing that potential clash, how diminished, how lacking, how much are we undermined because we don't have an agency that is capturing for us either the most innovative technology, or ordering it for the Congress, as these various new either innovations or failed innovations are coming to the forefront? And if you would, give your most honest answer of the restoration of the funding for this as an answer to its present hiatus.

Dr. Blair. Well, let me say first that I think that there was a hope when OTA was closed that other agencies in the Congressional complex would be able to fill the gap, and to a limited extent, some experiments are ongoing that may, that are attempting to address that. I think they will get----

Ms. Jackson Lee. Being very polite, Dr. Blair.

Dr. Blair. I believe that the gap is a large one, and it continues to this day, and the--some function needs to be re-injected into the Congressional infrastructure in order to fill that gap. I think we have all expressed that view today.

I do think that a resurrected OTA, as I think I mentioned in response to a thing earlier, a question earlier, would have to be a different place. There would be many different features to it to respond to some of the criticism and shortcomings that

happened earlier, and it would have to network, I think, better with the other agencies of Congress to keep pace with the times.

Ms. Jackson Lee. Anyone else?

Dr. Teich. Yeah.

Ms. Jackson Lee. Are we suffering as Americans because of the lack of existence of some entity?

Dr. Teich. Well, you know, you are asking, what you are asking is kind of an alternative history of the last eleven years, and I happen to enjoy reading alternative history, but I am not very good at writing it, I am afraid. So, I can't honestly say, except to suppose, based on the--what I know about what OTA did during its tenure, that we would be better off today had it continued to exist, and I think it would have been interesting.

If OTA existed throughout most of its life in a Congress that was controlled in both Houses, for most of the time, by the Democrats, it would be very interesting to see how it would have functioned, and what studies it would have undertaken under Republican leadership over the last eleven years.

So, I think it--I can't answer your question, but I can say it certainly appears to me that it would--that we have lost something by its absence.

Ms. Jackson Lee. Did you want to answer? All right. Thank you so very much. Thank you, Mr. Chairman. I yield back.

Mr. Bartlett. [Presiding] Thank the lady very much. Dr. Holt.

Mr. Holt. Thank you, Mr. Chairman. I am pleased with the existence of this hearing, and the progress of this hearing, and I thank the Committee for allowing me to take part in it.

You know, science and technology shouldn't be looked to to provide the answer of what is right. So, you know--and there certainly are occasions--Mr. Rohrabacher mentioned cyclamates--where, in retrospect, science has evolved to different conclusions. That does not mean that we have nothing to learn from science and technology. It does not mean that all bets are off, that they have nothing to tell us, and we should wing it with respect to what faces us.

OTA did not present conclusions. In fact, they were scrupulous about that. They laid out a range of choices, including the constraints that were presented by science and technology, and some people took that to mean conclusions. Now, one of the famous examples, of course, was the idea of a global missile defense, where the OTA pointed out that some of the desired or claimed properties of that were unattainable from a scientific and engineering point of view. That was taken to be a conclusion, when really, it was just, I think, a fairly objective look at the constraints placed by science.

I certainly think that, in answer to Mr. Bartlett's questions about the supply of uranium and the energy yield of ethanol, and all of those other things, if OTA had existed over the past 10 years, we could have expected studies, a study or studies, that would have laid out the range, and assigned some weight to our uncertainties about the range in the supply of uranium, or the energy yields of ethanol, and so forth.

Well, I noticed that the panels, the panelists have been very judicious, I guess I would say, careful, even cautious in

making recommendations to us for what we should do in our plight. I have suggested that what we need is something that is permanent, and therefore, not ad hoc, not something that has to gear up each time a study is commissioned, that it be professional, in other words, it would consist of professionals in this permanent, full-time staff that command the respect of the S&T community, and also, in the sense, professional, meaning that it would be scrupulously nonpartisan. And I would argue that, by the way, that OTA probably would not have behaved any differently under Republican leadership than Democratic leadership because the advisory board was scrupulously bipartisan. That we need something that would be in-house, and by that, I mean it would speak our language, it would understand our processes. It would lay out things, the choices before us in a way that is relevant, legislatively relevant.

And also, something that hasn't been discussed this morning, something that would be part of the life of the Hill. When you have got 100, more or less, professionals who are mingling with the staff, are here and there day in and day out, it elevates the debate. Even if they have not yet completed their result, their report, even if they have not and never will come up with a policy conclusion to help us in our job, they are part of the life of the Hill.

So, you know, when Harry Truman said he longed for a one-armed economist, who wouldn't say on the one hand and on the other hand, let me ask you to raise only one hand, and say do you agree that we need something as I have just described, that is permanent, professional, in-house, in order to provide what we need?

Dr. Blair. Can I----

Dr. Teich. Yes.

Dr. Blair. Can I elaborate on----

Dr. Teich. I am sorry.

Dr. Blair. Please.

Dr. Teich. And I think I would add, as you implied, bipartisan, as well.

Mr. Holt. Well, in fact, when I say professional, that--I mean both commanding the respect of the S&T community, and scrupulously nonpartisan or bipartisan.

Dr. Blair. One aspect of what you describe, I would like to elaborate a little bit more on, which harkens back to the OTA days, but also could be possible in other venues as well, and that is this notion of a shared staff. The idea that in the course of an assessment--I remember vividly the one we were doing on increased competition in the electric power industry at the time--that constant interaction throughout the course of the assessment with Congressional staff was very important to help the committees of jurisdiction and interest in really understanding all of the information that was coming before those committees at the time.

And they build up a body of expertise, a current, comprehensive body of expertise that could be called upon in the course of those kinds of deliberations. So, that is a resource that is often not cited in the kind of organization we are talking about, but this notion of a shared staff is a particularly important one, I think.

Mr. Ehlers. [Presiding] Any other comments? I didn't see any right hands go up.

Dr. Peha. I think that we need something that is permanent. We need something that is professional, and we need at least a piece of this to be in-house. I also think in the last decade, everybody else in the world has learned how to move workflows around a lot better than we used to, and we could perhaps make better use of universities and think tanks and others things than we used to, but everything should flow through something that is in-house.

Mr. Ehlers. Dr. Hunt, did you have anything to add?

Dr. Hunt. I agree. I say yes. This is what we need, and we need the scientists to be nonpartisan.

Mr. Ehlers. Thank you. I would just comment.

Mr. Holt. So, I would suggest, Mr. Chairman, we could call it this permanent, professional, in-house organization, we could call it TAO, OTA, or we could call it, if we wanted to feel our oats, OATS, the Office of Assessment of Technology and Science.

Mr. Ehlers. I see that you have given this some thought. Well, I feel like the Terminator, because I walked in the door, and someone said could you--can you chair it and terminate the hearing? I don't know if everyone else gave up. I apologize. I had to leave for another urgent meeting, which went far too long, and I lost my temper. But other than that, I am back here. I will not ask any questions, because I missed most of the testimony.

I--just a couple of observations. First a quick one. Being professional does not ensure bipartisan. I am a professional, and I am a Republican. And Mr. Holt is a professional, and is a Democrat, or professes to be. It takes more than that to guarantee----

Mr. Holt. It is nice to see the physics caucus on the dais.

Mr. Ehlers. Yes. Well, we have a bipartisan physics caucus. And so, being bipartisan means you have a balance of views represented, and I--there are--I was here when OTA was killed, and as far as I can discern--and I opposed that--as far as I can discern, their two items were lack of rapidity in replying and, secondly, the Republicans had a feeling that the Democrats used it to their own advantage, which would not be too surprising, because they had been in power the entire time it existed. In a sense, if we are going to do anything, we have to overcome that perception, because the perception is still there. It is not as strong as it was, but the perception is still there.

We have made do, not particularly well, but not particularly badly, either, by getting our rapid advice from CRS and our long-term advice from the National Academies, which is not all bad. But if we are to have something in-house, we have to be aware of the history, and design a program that assures that we do not have the faults, real or perceived, of the predecessor.

And I have talked to Dr. Holt about this a number of times, also Congressman Amo Houghton, when he was here. He was an avid fan of it, and he and I had joined in trying to stop the slaughter, when it was killed. But it was killed, and we have to face that, and we have to come up with something that is a new, improved model, and that really has some advantages. I

think there are huge advantages to having such an organization. It is not self-evident, however, to nonscientists, non-technical people.

Another solution, of course, would be to give the Science Committee jurisdiction over everything in this august body that relates to science, which would decimate a few other committees, and who would not willingly give up jurisdiction. But that would be an improvement, too, because I think we in this committee tend to handle things rather professionally, and reasonably, most of the time bipartisanly.

So, with those comments, I will say more power to Mr. Holt and others who are working on this. But I think the difficult problem, two difficult problems. One is designing a system that is going to work well. Second, even more difficult problem, is selling it to the Congress, and I think it is going to take a lot of combined work on all those who are interested, both inside and outside the Congress, to make that come about.

With that, I am pleased to thank you for your input. You have been very helpful to us in the things you have said and the background from which you say them. And I thank Mr. Holt for repetitively raising this issue. He is much younger than I, and therefore, he will probably survive in this atmosphere much longer than I do, and so, I am going to leave the task on his shoulders. And I will be in a supporting role as much as I can.

With that, I am pleased to declare the hearing adjourned.
[Whereupon, at 12:12 p.m., the Committee was adjourned.]

Appendix 1:

Answers to Post-Hearing Questions

Responses by Hon. Rush Holt, a Representative in Congress from the State of New Jersey

Q1. Dr. Holt, as a scientist and a politician, please discuss, in detail, your perspective on the state of scientific and technological assessment and advice for Congress.

A1. The state of scientific and technological assessment and advice for Congress is not where it should be, given the number of issues we consider each day that contain scientific and technological components. Technological assessment is the evaluation of new results considering not only technical details but also the implications of the various policy choices implied by the technology. When we discuss scientific and technological assessment for Congress, we include benefit and risk analysis, as well as the transition costs. An example includes the management of the transition of the conventional switch-line telephone system to using the Internet for phone and other communication methods such as e-mail.

Congress recently dealt with such issues as health care, missile defense, and net neutrality, each of which has technological components. Not so obviously, issues like pension reform, technical education, first responder issues, and voting reform each have a

technical component as well. Committees hold hearings on these topics, sometimes, however, without addressing the scientific and technical components. Members of Congress may or may not recognize the technological aspects of an issue and obtain necessary advice or assessments. Congress itself lacks an organization to complete analysis on the scientific and technological components of a bill.

Congress does have non-partisan and objective organizations designed to answer certain types of questions. We have the Congressional Research Service (CRS), for example, which is designed to research and report on all legislative issues, and provide answers rapidly. CRS is an excellent resource for Congress. They provide non-partisan, objective, comprehensive, and reliable research on legislative issues in a timely manner for Congress. We also have the General Accountability Office (GAO), which serves the Congress by assessing the effectiveness of government spending. The Congressional Budget Office (CBO) provides Congress information and estimates to guide budgetary decisions. Yet, none of these bodies is chartered or equipped to provide in-depth scientific and technological analysis to the Congress.

There are organizations outside the infrastructure of Congress that do provide scientific and technological assessment and advice. The National Academies of Science (NAS) brings together committees of experts in areas of scientific and technological endeavors to address critical national issues and give advice to the Federal Government. This advice usually comes in the form of reports, and the advice within these reports--depending on the topic and mission of the committee of experts--may include advice based on technological analysis. Most often, NAS reports are based on the opinions and expertise of the members of the committee, and the NAS goes to great lengths to ensure that there is no conflict of interest for any committee member. This process, both necessary and appropriate, increases the time of completion of the Academy reports. Given the often rapid pace of legislative decision-making, the Academy reports frequently fail to reach Members and influence the debate. These reports are not usually directed specifically for the use of Congress, and they are not written with an understanding of familiarity of the needs, the language, and the procedures of Congress.

Similarly, scientific and technological professional societies work to advise Congress. Unlike the work of the Academies, however, we must recognize that professional societies work for their members, and their advice may not always be politically neutral. Additionally, professional societies also do not necessarily provide technical or policy analyses for Congress. The same is true for researchers in academia, industry or in public-private partnerships.

Until 1995, the job of providing objective and authoritative analysis of complex scientific and technical issues to Congress fell to the Office of Technology Assessment (OTA). The OTA was designed to produce scientific and technological analysis for Congress and to serve as resource to Members of Congress and their staff. In its twenty-three years of existence, the OTA issued 703 reports on topics ranging from substance abuse to nuclear war specifically for Congressional needs. OTA's structure included a Technology Assessment Board (TAB) composed of six Senators and six Representatives, with the chairmanship and vice-chairmanship alternating between the Senate and House each Congress. The OTA also had an Advisory Council of ten eminent citizens from academia, industry, and other institutions outside the Federal Government, appointed by the TAB. Statutory Members of the Advisory

Council included the Comptroller General of the U.S. and the Director of the CRS. Chairmen and Ranking Members of committees could request work personally or on behalf of a committee member. The OTA staff and Director then reviewed these requests to determine whether the OTA could provide the information effectively and whether the interest was broad and bipartisan. During the course of the study, the OTA assembled an advisory panel of stakeholders and experts to ensure that the study was objective, fair, and authoritative. However, no attempt was made to reach consensus amongst the panel members. This ensured that differing views were not stifled. Less formal advisory opportunities were also sought with other outside experts and advisors.

For a more detailed explanation of the assessment process, please see Appendix A: The Assessment Process, downloaded from <http://www.wws.princeton.edu/ota/ns20/proces<INF>-</INF>f.html>

The OTA evolved over time, restructuring and reorganizing to meet Congress' changing needs. In the end, the OTA employed 143 people and had a budget of \$20 million. Not only were lengthy studies completed, but also shorter works as committee staff and Members requested or as OTA staffers perceived an upcoming need. In Appendix B, I have included some of the budget justification statements by the OTA to illuminate its impact on legislation and the workings of Congress.

In 1995, Congress voted to defund the OTA. In doing so, Congress lost the body that crafted reports relevant to the scientific policy issues at hand. It also lost insight into the interdependence of various technical aspects of a complex problem, implications of policy decisions, and options available to provide policy-makers. The OTA's work was credible, thorough, and fair. Its absence has left a gaping hole in our ability to understand and address thoughtfully the complex scientific and technical aspects of the issues we face every day.

Q2. Dr. Holt, given your perspective, how would you improve the current process or implement a new process for Congress to receive scientific and technological assessment and advice?

A2. The Office of Technology Assessment (OTA) is the place to start when considering what Congress needs to do to improve the scientific and technological assessment and advice it receives. The OTA completed authoritative, thorough studies, many of which are still relevant today. Studies were initiated through the request of a Chairman of any congressional committee. This request could be on behalf of the Ranking Member of the Committee or on behalf of a majority of the committee, and many requests were supported by more than one committee. The OTA Director and staff then determined whether the interest of the request was broad and bipartisan, and whether the OTA had the resources to complete the study. The request was then sent to the Technical Advisory Board, a bipartisan, bicameral board of twelve Members of Congress, which determined whether to proceed or not with a study. In addition, the OTA had an Advisory Council, composed of ten eminent citizens from academia, industry, and the Federal Government to advise the OTA.

Once a study was approved, a comprehensive advisory panel of technical and relevant stakeholders was assembled to ensure the reports were objective, thorough, fair, and inclusive of a diverse set of viewpoints. A core team composed of OTA staff, contractors, and consultants was assembled with an experienced project director selected, along with contractors and consultants. Each report was subject to an extensive formal review process that included OTA staff and outside experts. Once the assessment was approved by the OTA

Director, copies were sent to the members of the Technical Advisory Board for review and authorization. Approved reports were then released, with copies going to the requesting committee or committees. Summaries were sent to Members, and then released to the public. Often, delivery of the report's content followed channels such as congressional briefings, hearings, and follow-up consultation between the OTA and congressional staff. Many of the studies are still available online.

To further illuminate the successes of the OTA, I have included (in Appendices B-K), the OTA Justification of Estimates for Legislative Branch Appropriations from 1987-1996. Beyond its service as a shared resource for the committees of Congress, the OTA interacted with staffs of other federal agencies within both the Legislative and Executive branches, as well as with the private sector and universities. For example, OTA reports were often cited as justification for actions of agencies. The OTA also participated in workshops, interagency working groups, and commissions. It provided its expertise to organizations such as the National Governor's Association, the Council on Competitiveness, and the National Academies of Science. In each Justification found in the Appendices B-K, one can find a yearly summary of this interaction with federal agencies, universities, and the private sector.

Additionally, the Justification of Estimates found in the Appendices B-K, included a summary of the direct legislative use of each OTA division's work. Reports were often used as background material for legislative activities, used in debates on bills, referenced during or the focus of hearings or testimonies, and assisting in the drafting of legislation. OTA recommendations are often cited as aspects of bills moving through the Senate or House. Conversations and discussions with Members of Congress or staff are also cited in conjunction with work on particular legislation. The OTA was an integral part of the legislative process in both the Senate and the House of Representatives.

We no longer have the OTA. As a result of the OTA's demise, Congress lost not only its own scientific and technical assessment body, but the resulting broad interagency collaboration, coordination, and outreach that the OTA also provided. The operation of OTA was not expensive, but considering the cost of ignorant mistakes of policy, OTA would have been a bargain at several times the cost. Ill-informed decisions result in huge amounts of financial waste. In order to be fiscally responsible, we need a body to give us scientific and technological assessment. Currently, the bodies which serve Congress, the CRS, the GAO, and the CBO, do not have a mission focused on scientific and technological assessment and its implications.

As we look to meeting the scientific and technological needs of Congress, I believe the in-house, professional, permanently staffed body needs to reflect much of the structure and function of the Office of Technology Assessment. It served Congress well. However, in seizing this opportunity to strengthen scientific and technological advice, we must be sure that any new entity meets certain criteria.

Scientific and technological assessments require objectivity and political neutrality. We naturally expect the CRS, the GAO, and the CBO to handle assignments at the same professionalism, and there is no reason to believe that an updated OTA would not maintain the same high standard.

Studies must be timely and relevant. By crafting a management structure to accommodate both longer term studies of topics and studies

to be completed on a shorter time scale, this new body can help ensure that Congress makes informed, well-reasoned decisions. A way to achieve this is to enable Representative or Senator to request a study. This not only broadens the perspective and usefulness of the entity, its also reduces the possibility of partisanship, since both parties can make requests independently.

Some have suggested building this capacity into the GAO. This idea is not without perils. For example, the Comptroller General would most likely maintain final say on the studies completed, negating the bipartisan decision-making structure that Members of Congress have said they want. The same danger exists if the entity is placed within the CBO or CRS. Budget concerns would also become an issue. When money gets tight, the scientific and technological assessment group could be the first cut, given that scientific and technological assessment and analysis do not fall within the missions of the GAO, CBO, or CRS. Would I take this scenario over nothing at all? Yes, with appropriate negotiating. Is this scenario ideal? No, it is not.

It is time that Congress take action to give itself an in-house, permanently and professionally staffed body to complete scientific and technological assessments. When OTA existed, other countries came here to learn about the OTA with the purpose of creating such a body for themselves. We were the world leader in this arena, and we can be again.

<GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT>

Answers to Post-Hearing Questions

Responses by Jon M. Peha, Professor, Departments of Engineering and Public Policy and Electrical and Computer Engineering, Carnegie Mellon University

Questions submitted by Representative Eddie Bernice Johnson

Q1. Do you feel it would be beneficial for Congress to have its own internal scientific advisors such as the Office of Technology Assessment Congressional Board? If so, how can we make sure the advice structure would be nonpartisan?

A1. Yes, Congress needs internal advisors with significant expertise in science and technology, where internal means in an organization dedicated to serving Congress as CRS, GAO, and CBO do today. One way to insure that the program remains nonpartisan is to establish a Technical Assessment Board or Congressional Board for oversight. This bipartisan bicameral Board should contain an equal number of members from the majority and minority party. All important decisions should require a majority vote, which means there must be support from both parties. Moreover, the Chairman's power must be limited so the views held by the majority will prevail.

The Board would be responsible for determining which studies are undertaken, and for agreeing upon their scope, cost, and duration with professional staff. The Board must insure that the studies produced are of interest to both majority and minority parties. It will help if they systematically give preference to studies that have been requested by many members from both parties, as might be quantified by the number of Republicans signing a letter of support times the number of Democrats

signing a letter of support.

The Board must also approve major the selection of a Director. They should select a Director that has outstanding credentials as a scientist or engineer, and experience producing or overseeing balanced nonpartisan analyses of complex policy issues related to science or technology. Some experience with Congress is also important, but extensive service advancing one party over the other is probably a liability rather than an asset. A highly partisan choice is unlikely to gain support from a majority of the bipartisan Board.

Other safeguards against partisanship must be embedded in the organization and its procedures. Studies should not be designed to produce legislative recommendations; they should frame issues, and analyze options. Clearly that analysis must be rigorous and nonpartisan. It helps to conduct outside reviews of each study from a diverse set of reviewers, and to take all the reviewers' constructive criticism seriously. In many cases, outside review is required at more than one stage of the study. This review process goes far beyond the typical fact-checking that would be done today in GAO or CBO. In addition, a culture of nonpartisan professionalism must permeate the organization, and be sustained through hiring and promotion criteria that reward solid balanced analysis rather than convenient answers. History shows that this can be achieved under appropriate leadership from a highly qualified Director.

Answers to Post-Hearing Questions

Responses by Albert H. Teich, Director of Science and Policy Programs,
American Association for the Advancement of Science

Questions submitted by Representative Eddie Bernice Johnson

Q1. Do you feel it would be beneficial for Congress to have its own internal scientific advisors such as the Office of Technology Assessment Congressional Board? If so, how can we make sure the advice structure would be nonpartisan?

A1. As I indicated in my testimony, I believe that Congress needs timely analysis and synthesis of scientific and technical information as a foundation for its decision-making. It is my view that an organizational mechanism that is directly responsive to congressional requests would serve this need most effectively. Experience suggests that establishing an internal body (i.e., a congressional service agency whose staff is employed by Congress) is the best way to guarantee responsiveness. The staff should be high quality and include experts in both science and policy. Staff members need not--in fact it cannot--be expert in all science and technology policy areas likely to come before Congress, but they should have the ability to draw upon external expertise as necessary. That expertise might reside in other congressional service agencies (e.g., CRS or GAO) or it might be found in the National Academies, scientific associations, think tanks, or the broader scientific and policy community.

Assuring that this structure would be nonpartisan is more complicated. I don't have a ready answer, but I would suggest that Members examine carefully the existing sources of nonpartisan information and advice for Congress--CRS, GAO, CBO, and the National Academies--and identify and analyze the traits that best facilitate their insulation from partisanship. These shared traits likely include

some combination of an independent, bipartisan oversight mechanism and the ability to protect their staffs from undue political pressures. It may also be useful for the advice structure to have its analytical processes (e.g., workshops and meetings) rendered in a public rather than in a private setting, except in instances where secrecy is needed to protect national security.

Answers to Post-Hearing Questions

Responses by Peter D. Blair, Executive Director, Division on
Engineering and Physical Sciences, National Academy of Sciences

Questions submitted by Representative Eddie Bernice Johnson

Q1. Do you feel it would be beneficial for Congress to have its own internal scientific advisors such as the Office of Technology Assessment Congressional Board? If so, how can we make sure the advice structure would be nonpartisan?

A1. Reactivating the former Office of Technology Assessment's Technology Assessment Board (TAB) is certainly one expedient option for filling the gap in advice the Congress is currently receiving, as essentially all witnesses noted in the hearing (since it would only require appropriations and not authorizing legislation). There are other options as well but the construction of mechanisms for nonpartisan operation would be essential to the credibility of the advice it offers and to ensuring both such an organization's usefulness and direct accountability to the Congress.

As a historical reference, the TAB structure as originally incorporated into the OTA authorizing legislation was perhaps the most important organizational mechanism for ensuring a nonpartisan operation. Construction of something analogous in any new entity would probably be very challenging to maintain, especially if the organization were located outside the Congress. I pointed out in my testimony that if an OTA-like institution existed today, it would likely have a number of important differences from the OTA that existed between 1972 and 1995, but the mechanisms for ensuring independent and nonpartisan analysis are not really among those differences, since those mechanisms were painstakingly constructed to achieve both bicameral and bipartisan balance in the agency's oversight and governance.

A TAB-like body would be essential to any such organization in ensuring both relevance to the Congressional agenda and balance in its governance in several dimensions. At the former OTA, TAB's composition was unique among the legislative support agencies--a twelve-member governing board with six members of the Senate and six of the House, divided exactly equally between the political parties. TAB's principal responsibilities were to appoint the Director, to authorize the initiation of assessments requested by Congressional Committees, to approve the budget authority associated with each of those assessments, and finally to authorize delivery of assessment reports to requesting committees and the public by certifying that OTA has carried out its assessment process faithfully, i.e., that OTA has considered all the relevant stakeholder interests and issues and undergone and responded to extensive external review. For your reference, I recap the strengths and weaknesses of these features in more detail in the 1994 paper I prepared on the subject, Technology Assessment: Current Trends and the

Myth of a Formula (available at <http://www.wws.princeton.edu/ota/>) as well as in the more recent report I included for the hearing record.

As a point of reference, in the early days of OTA many thought that TAB would not work. It was predicted by some that TAB would either become a disinterested body or a dysfunctional one due to partisan disagreements. But as the agency matured organizationally, neither of these predictions happened. Board members were appointed by the leadership in both the House and the Senate and included very senior members of Congress from both political parties, some of whom are still in Congress today. The board met approximately every six weeks when Congress was in session with a strong turnout and with few disagreements reflecting party or ideological lines.

One historical anecdote illustrates the effective functioning of the TAB at OTA. A TAB member voted in the board meeting to authorize the release of a somewhat controversial study on the technological future of textile industry, acknowledging that the assessment process had been completed effectively. The next day, however, he issued a press release politically criticizing some of the alternative policy options identified in the report's conclusions. Some felt that this was inconsistent and perhaps even hypocritical, but actually he had honored both his responsibilities. First he honored his responsibility on the board by not letting the implications for his constituents of some the identified alternative policy options affect his position on the overall perspective of the report. At the same time and in a separate venue, he accommodated the political concerns of his constituents by disagreeing with those options that were not in their interests.

This anecdote also underscores a fundamental point I was trying to make in my testimony. There are many organizations that can provide important input to Congressional deliberations and at least a few, such as the National Academies, that can offer highly authoritative, independent and objective consensus findings and recommendations from a widely recognized group of experts on technical issues. However, there are essentially no organizations well-equipped currently to inform the Congressional debate on complex science and technology issues with perspectives that may go beyond science and technology to include the broader implications of alternative actions or options related to the science and technology issues being considered and, especially, a comprehensive evaluation of such perspectives with mechanisms in place to ensure independence and balance of that evaluation.

Answers to Post-Hearing Questions

Responses by Catherine T. Hunt, President-Elect, American Chemical Society; Leader for Technology Partnerships, Rohm and Haas Company

Questions submitted by Representative Eddie Bernice Johnson

Q1. Do you feel it would be beneficial for Congress to have its own internal scientific advisors such as the Office of Technology Assessment Congressional Board? If so, how can we make sure the advice structure would be nonpartisan?

A1. I do feel strongly that it would be very beneficial for Congress to have its own internal scientific advisors. Currently, Congress has two internal sources for obtaining input on scientific and technical issues--the Congressional Research Service, which provides excellent background and summary documents, and the General Accounting Office, which performs economic analyses. Congress also can utilize the

National Academies to secure in-depth, long-term analyses of scientific and technical issues. Each has its strengths, yet something is missing: an internal agency that provides a data- and information-based policy analysis to meet Congress' specific decision-making needs.

Since the Office of Technology Assessment was eliminated in 1995, Congress has functioned without an impartial internal unit that can frame complex issues, provide comprehensive and balanced insights and analysis, and set out policy options on science and engineering issues. These issues require more than facts and short reports, they need adequate scoping, integration and non-partisan analysis of large-scale issues involving science and technology. Congress clearly should continue to utilize outside experts in this regard, including the National Academies, but they cannot meet all of Congress' frequent and extensive needs.

The need for timely, comprehensive technical analyses is clearly demonstrated by the success that Fellow programs, such as the one coordinated by AAAS, have had on the Hill. Individual Members of Congress have certainly recognized the need for scientific input in making policy decisions, but unfortunately, with only 35 or so Fellows available each year, these programs cannot fill all the needs of all the Members. A new congressional agency would ensure that such information would be available to all.

The second part to your question, about ensuring that the advice is nonpartisan, is a difficult one for me to answer. My experience is as a scientist, not a politician, so I will defer to the experts in Congress on the details of this question. However, I can hopefully add some insight by highlighting the main tool my field uses to maintain integrity: peer review. It is a central tenet of practicing scientists. Journal articles and reports are often sent out for both internal and external reviews by experts. This enables us to find errors, correct misinterpretations, and generally improve our work. Reports written by a new congressional unit should be subject to a similar process. Employees would have to rely significantly on outside experts and to refine their analyses. If the data and the analyses are correct, they should hold up to external scrutiny.

Appendix 2:

Additional Material for the Record

<GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT>

Scientific Advice for Policy in the United States: Lessons from the National Academies and the former Congressional Office of Technology Assessment

Peter D. Blair\1\

\1\ The author is Executive Director of the Division on Engineering and Physical Sciences of the U.S. National Academies. He was formerly Assistant Director of the U.S. Congressional Office of Technology Assessment (OTA) and Director of OTA's Division on Industry, Commerce,

and International Security. Conclusions in this paper are the author's and are not necessarily those of the National Academies. This paper is an expansion of Ahearne and Blair (2002) and includes descriptions drawn from Blair (1994 and 1997) and The National Academies (2005a). The author greatly appreciates the advice of a number of reviewers, including John Gibbons, Christopher Hill, Jim Turner, Michael Rodemeyer, Jonathan Epstein, and E. William Colglazier.

The National Academies
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ABSTRACT

In the United States the National Research Council (NRC), the ``operating arm'' of The National Academies, is a widely used source for science and technology policy advice by government agencies and the U.S. Congress. Operating under an 1863 charter issued by Congress for the independent and non-government National Academy of Sciences, the NRC today delivers around 250 reports to government annually, spanning a wide spectrum of important science and technology related issues. NRC reports are viewed widely as valuable and credible because of the institution's longstanding reputation for providing independent, objective, and nonpartisan advice with high standards of scientific and technical quality.

The NRC study process is tuned primarily to the needs of federal executive agencies but carries out on the order of 25 studies annually requested by the U.S. Congress as well. The former Congressional Office of Technology Assessment (OTA) was an analytical support agency created by Congress in 1972 but closed down in 1995. During its existence OTA produced on average 32 assessment reports annually (703 in all over the agency's 23 year existence and on average 51 reports per year in the last three years), primarily for the standing committees of the Congress, using a process that produced reports on science and technology policy issues and accompanying advice tuned specifically to Congressional needs.

This paper explores and compares the study processes of the NRC and the former OTA, drawing conclusions from the comparisons that relate, in particular, to the relative strengths and weaknesses for ensuring quality, independence, authority, and relevance in providing science and technology advice to government and, in particular, the legislative branch of government.

INTRODUCTION

The pace of science and technology advancement over the past half-century has delivered enormous benefits to societies throughout the world as well as sobering challenges associated with the role of technology in virtually every aspect of our lives. While reaping the benefits, all of society must also cope with the challenges.

Over two centuries ago as the American democracy took shape, the founding fathers of the fledgling republic worried that democracy could

flourish only when the electorate and, in particular, the institutions of government serving it are well informed about the issues upon which they must decide. Today, and increasingly, as science and technology issues become more and more prevalent, prominent, complex, and of far reaching impact on society, a democratic government poorly informed about such issues carries greater and greater risk in making bad policy choices. Yet, it is also becoming increasingly more difficult for anyone, or even any one institution, to keep pace with the frontier of scientific knowledge and its impact on society. In addition, over the last quarter century, the information revolution has expanded the quantity of information accessible to government policy-makers, but more information has not proved to be necessarily better information. Indeed, a fundamental problem today is not the lack of information; rather, it is how to gauge validity and usefulness within the torrent of available information and advice.

How then can government policy-makers acquire useful, relevant, informed, independent, authoritative and timely advice on the science and technology dimensions of the issues they face? This paper reviews the current and evolving role of the U.S. National Academies in providing advice to government as that role compares with other current sources of advice. For this conference, also considered more specifically are the mechanisms of quality control in the study process of the National Academies, again as it compares with other sources of advice, and in particular with that of the former Office of Technology Assessment (OTA)\2\ and with special attention to the Congressional needs for science and technology advice. Also, for purposes of this paper, the characterizations of the Academy and OTA study processes are stylized in that they are described in the ideal and most common study situations, although in both cases there were considerable variations around the specific processes presented here.

\2\ The Congressional Office of Technology Assessment (OTA) was an independent analytical support agency of the U.S. Congress that was created in 1972 and operated from 1973-1995. The authorizing legislation for OTA still exists, but Congress no longer appropriates funds for its operation.

THE ROLE OF THE NATIONAL ACADEMIES

In the U.S. among the most familiar sources of independent scientific and technical advice to the Federal Government is the collection of non-government organizations we refer to today as the National Academies, comprising the National Academy of Sciences (NAS), the National Academy of Engineering (NAE), the Institute of Medicine (IOM), and their collective ``operating arm,' ' the National Research Council (NRC).\3\ In 1863 the U.S. Congress chartered the NAS as an independent non-profit corporation to ``whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art.' ' This charter was signed into law by President Abraham Lincoln during the height of the U.S. Civil War.

\3\ More detailed descriptions can be found at The National Academies (2004) or Ahearne and Blair (2003).

Today the NAS, NAE, and IOM are prestigious and highly selective

honorary societies that each elect among the most respected scientists and engineers in the world as new members to their ranks annually. The Presidents of the NAS and NAE serve ex officio as the Chair and Vice-Chair, respectively, of the NRC. The NRC assembles committees of experts including many academy members to provide advice in the form of study reports to executive branch agencies of government, but the U.S. Congress also frequently mandates studies to be carried out by the NRC.\4\ NRC studies span a wide spectrum of science and technology related issues, resulting in around 250 reports\5\ annually, involving nearly 10,000 volunteers serving on study committees and in the review process as well as utilizing over a 1,000 professional staff to manage and facilitate the efforts of study committees.

\4\ Academy studies carried out for Congress are usually executed under contract to executive departments and agencies as directed by Congress in authorizing or appropriations legislation.

\5\ See The National Academy Press (2002), The National Academies (2005c), or the National Academy of Sciences (2005).

NRC reports are viewed widely as being valuable and credible because of the institution's longstanding reputation for providing independent, objective, and nonpartisan advice with high standards of scientific and technical quality. The key strengths of the NRC in providing advice to the U.S. Government rest principally on the history of convening very high quality expertise for its study committees and on the reputation for maintaining important quality control features for independence and objectivity of reports prepared by those committees. In particular, over the years as the NRC study process evolved, many checks and balances have been incorporated to ensure quality and protect the integrity of reports thereby helping to maintain public confidence in them. In 1997 many of these checks and balances, supplemented with some additional features, were codified into federal law as NRC advice to the government became subject to a new provision of the Federal Advisory Committee Act (discussed later). In short, the NRC study process is widely accepted as a high standard for independent scientific advice to government.

Key Strengths of the NRC Study Process

These commonly cited principal strengths of the NRC study process include the following:

<bullet> **Credibility.** The NRC's institutional credibility is enabled in part by its association with the NAS, NAE, and IOM. In addition, the process by which the NRC conducts its work is designed to ensure the results are evidence-based and tightly reasoned as well as independent from outside influences and pressures from various interest groups including government agencies and congressional interests. The Academies also conduct several studies each year using their own limited endowment resources rather than those of external sponsors. These self-initiated studies often focus on topics that the Academies leadership believes to be important but that the government may not be willing or able to sponsor on a schedule timely enough to be useful. One such example was the 2002 study, *Making the Nation Safer: The Role of Science and Technology in Countering Terrorism*, which followed the

terrorist events of September 11, 2001 in the U.S. Another is the recent report, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*, which puts forward recommendations for a comprehensive and coordinated federal effort to bolster U.S. competitiveness and preeminence in science and technology.

<bullet> Convening Power. The NRC seeks to invite the ``best and the brightest'' to participate in its studies and those invitations are generally accepted. Studies are carried out by groups of volunteers who are identified not only as broadly considered among the best experts on the issues to be studied, but also are determined through a well documented process to be free of conflicts of interest, and represent a carefully balanced set of perspectives on those issues. It is widely perceived as a prestigious honor to serve on an NRC committee and, because of the breadth of membership in the academies and the links of the organization to the scientific and technical communities worldwide, the NRC is well equipped to identify leading experts to serve on study committees.

<bullet> Study Process and Products. A highly structured process guiding NRC studies has evolved steadily over the years, but has always been and continues to be designed to maintain balance and objectivity throughout a committee's work and to produce reports considered to be both unbiased and authoritative. A key quality control feature in the process is independent peer review. After consensus is achieved by a study committee and a draft report is prepared, the NRC process requires the committee to address all of the comments from a carefully selected collection of reviewers, whose identities are not revealed to the committee until the study is publicly released. The review process is managed by a monitor appointed by the Report Review Committee, which is an independent committee of the National Academies (discussed more later).

Overview of the NRC Study Process

The NRC study process can be defined as a sequence of five major stages: (1) study definition, (2) committee selection, (3) committee activity (meetings, information gathering, deliberations, and report preparation), (4) report review, delivery and public release, and (5) final publication and dissemination.\6\

\6\ Much of this description is adapted from The National Academies (2005a). More detailed descriptions of the NRC study process include National Research Council (1998, 2000 and 2005b).

STAGE 1. Study Definition

Management and staff of the National Academies along with members of oversight committees (known as boards) appointed by the chair of the NRC are responsible for oversight of specific segments of the overall NRC study portfolio. There are around 50 such boards in the NRC organization, such as the Board on Energy and Environmental Systems or the Board on Life Sciences. These groups interact with sponsors to define the specific set of questions to be addressed by a prospective study resulting in a formal ``statement of task'' (SOT) as well as the

anticipated duration and cost of the proposed study. The SOT defines and bounds the scope of a prospective study and serves as the basis for determining the expertise and the balance of perspectives needed on the committee that will be recruited to carry out the study. In addition, the SOT serves as a fundamental point of departure for subsequent independent peer review of the draft report prepared by the study committee.

The SOT, and the accompanying detailed plan for executing the committee's work, and the project budget are all reviewed and approved or revised by the Executive Committee of the NRC Governing Board (GBEC) comprised of elected and appointed officials of the NAS, NAE, and IOM. This review can result in changes to the proposed SOT and work plan and, on occasion, results in turning down proposed studies that the institution, after consideration, believes are inappropriately framed or not within the charter of the National Academies. Following GBEC approval and execution of a contract (or grant)\7\ specifically for that study with the agency sponsor, work begins on the study itself.

\7\ Costs for NRC studies sponsored by government agencies are covered and accounted for via specific contracts for each study individually. For a variety of reasons (discussed later in this paper) the NRC has been reluctant to operate under a more centralized funding mechanism with the government, such as an annual appropriation from Congress.

STAGE 2. Committee Selection

Members of NRC study committees are formally appointed by the Chair of the NRC. Committee members serve without compensation except for reimbursement of expenses associated with attending meetings. The selection of appropriate committee members for an NRC study, both the individuals selected and the composition of the group as a whole, is key to the credibility and authority often associated with NRC reports. A great deal of research by NRC staff and management takes place prior to appointment of a committee in order to identify the strongest possible candidates.

NRC committee members serve as individual experts, not as representatives of organizations or interest groups. They are initially appointed provisionally and a committee is not finally approved until a discussion of the committee's composition and balance is held at the first meeting where any issues regarding potential conflicts of interest or balance of perspectives represented on the committee that are raised in that discussion or by the public\8\ are investigated and addressed. This discussion and follow up consideration by NRC management sometimes results in changes to the committee membership. The goal of this process of analyzing the prospective committee's composition and balance is to ensure that committees meet the following criteria:

\8\ Provisional committee membership is posted on the National Academies Internet web site for a period of 20 days prior to the first meeting of the committee and the public is invited to provide comments on the committee composition and balance of perspectives.

<bullet> An appropriate range of expertise for the task. Committees are designed to include experts with the specific expertise and experience needed to address the study's SOT. One of the strengths of the National Academies is the tradition of

bringing together recognized experts from diverse disciplines and backgrounds who might not otherwise collaborate. These diverse groups are encouraged to conceive new ways of thinking

about problems.

<bullet> A balance of perspectives. While ensuring that the right expertise is represented on the committee is essential, it is not alone sufficient for an effective committee on most NRC studies. It is also important to evaluate the overall composition of the committee in terms of a diversity and balance of experiences and perspectives. The goal is to ensure that the most important points of view, in the National Academies' judgment, are reasonably balanced so that the committee can carry out its charge objectively and credibly.

<bullet> Screened for conflicts of interest. All provisional committee members are screened in writing and in a confidential group discussion regarding possible conflicts of interest. For this purpose, a ``conflict of interest'' is actually quite narrowly defined as any financial or other interest which conflicts with the service of the individual on the committee because it could significantly impair the individual's objectivity or could create an unfair competitive advantage for any person or organization. In particular, the term ``conflict of interest'' in the NRC study context means something more than individual bias. There must be an interest, ordinarily financial, that could be directly affected by the work of the committee. Except in very rare situations where the National Academies determines that a conflict of interest is unavoidable and promptly and publicly discloses the conflict of interest, no individual can be appointed to serve (or continue to serve) on a committee of the institution used in the development of reports if the individual has a conflict of interest that is relevant to the charge of the study committee. Many potential conflicts of interest, as opposed to real conflicts as defined above, are balanced by different viewpoints represented by other members of the provisional committee.

<bullet> Other considerations. Membership in the ``three academies'' (NAS, NAE, IOM) and previous involvement in National Academies studies are taken into account in committee selection. The inclusion of women, ethnic minorities, and young professionals are important as well, and additional factors such as geographic diversity and a diversity of institutional affiliations are also considered.

The specific steps in the committee selection and approval process are as follows: (1) academy staff solicit an extensive number of suggestions for potential committee members from a wide range of sources; (2) a recommended slate of nominees is put forward for approval through several levels within the NRC management, with the provisional slate ultimately approved by the NRC Chair; (3) the provisional committee member list is posted for public comment on the National Academies Internet site and members are asked to complete background information and conflict of interest disclosure forms, which are subsequently reviewed by academy management and staff.\9\ Then, (4)

a discussion of the committee's overall balance and potential conflicts of interest is held at the first committee meeting; (5) any conflicts of interest or issues of committee balance and expertise are investigated; and, if necessary, (6) changes to the committee are proposed and finalized before the committee is formally approved. Finally, (7) committee members continue to be screened for conflicts of interest throughout the duration of the committee's work.

\9\ The NRC conflict of interest disclosure process (National Research Council, 2003) is often cited as a high standard for documenting independence and objectivity in science and technology advisory bodies; see, for example, U.S. Office of Management and Budget (2005).

STAGE 3. Committee Activity

Study committees typically gather information through: (1) meetings that are open to the public and that are announced in advance through the National Academies Internet site; (2) the submission of information by outside parties; (3) reviews of the scientific literature (and other sources as relevant), and (4) the investigations of the committee members and staff. In all cases, efforts are made to solicit input from individuals who have been directly involved in, or who have special knowledge of, the problem under consideration. In accordance with federal law and with few exceptions, information-gathering meetings of the committee are open to the public.

Any written materials provided to the committee by individuals who are not officials, agents, or employees of the National Academies are maintained in a Public Access File that is available to the public for examination. The committee deliberates in meetings closed to the public in order to develop draft findings and recommendations free from outside influences.\10\ The public is provided with brief summaries of these meetings that include the list of committee members present (posted on the Academy's Internet site), but all analyses carried out by the committee and drafts of the report remain confidential. Occasionally academy studies employ contractors to provide supplemental analyses to support the staff and committee's work although this is typically not a major component of most studies.

\10\ Most groups created by the U.S. Government to provide advice operate under regulations pursuant to the Federal Advisory Committee Act (FACA), which does not permit, for example, such groups to operate without government officials present or in meetings not open to the public (along with many other requirements). The NRC operates under a special provision of FACA (Section 15) that permits closed committee meetings. Section 15 of FACA is included for reference as Appendix A.

NRC committees assume authorship of the study report, although in practice who actually drafts the report varies considerably. For example in many cases the appointed committee members draft much of the text at all stages of a report; in other cases committee members critique drafts prepared by staff; and often collaborative combinations of committee and staff authorship produce successive drafts.

STAGE 4. Report Review

As a final check on the quality and objectivity of an NRC study, all reports undergo a rigorous, independent external review by experts whose comments are provided anonymously to committee members. The NRC

recruits independent experts with a range of views and perspectives to review and comment on the draft committee report.

The Academy's report review process is structured to ensure that a report addresses its approved study charge and does not exceed it; that the findings are supported by the scientific evidence and that concluding arguments are presented clearly; that the exposition and organization of the report are effective; and that the report is impartial and objective. Each committee is required to respond to, but need not (necessarily) agree with reviewer comments in a detailed "response to review" document that is examined by one or two independent report review "monitors" responsible for ensuring that the report review criteria have been satisfied. After all committee members and appropriate academy officials have approved the final report, it is transmitted to the sponsor of the study (usually a government agency) and subsequently released to the public. Sponsors are not provided an opportunity to suggest changes in reports. The names and affiliations of the report reviewers are made public when the report is released.

\11\ This is, in part, necessary because study statements of task are contractually defined and, hence, sometimes result in committee's frustration at not being permitted to exceed the statement of task if the committee feels an expansion of the scope is warranted. It is generally considered the role of the institutional governance structures to ensure that a study's statement of task is properly framed.

STAGE 5: Publication and Dissemination

NRC reports are sometimes delivered and released to the public in the final published form, but more frequently are delivered and publicly released in a pre-publication draft format, and subsequently edited and produced in a final published form some time later. Press briefings, congressional and executive agency briefings, and other dissemination activities are common for many NRC studies.

Special Challenges for NRC Study Processes

Over the years the NRC process has proved consistently to be a very strong model for providing independent and authoritative advice to government. Like any process designed to serve many needs, however, it is not perfectly tuned to serve all the needs of all parts of government that need science and technology advice. The most commonly cited issues and challenges associated with the NRC study process are the following:

- <bullet> Cost. It is often perceived to be expensive to commission an NRC study, even though committee members are volunteers whose time is contributed pro bono (except for travel expenses). At least in part this perception is due to the fact that a separate contract is negotiated for each individual study--unlike the central funding for federal agency advisory committees. The overhead cost for the NRC is necessarily substantial, partly because many of the staff supporting studies are professionals who manage the activities of standing boards and committees as well as study committees and partly because supporting the infrastructure necessary to maintain access to key sources of volunteers, including the

governance structures of the National Academies, must be maintained. In general, the cost of an NRC study is perhaps somewhat higher than that of a comparable effort carried out by a university or nonprofit ``think tank'' and somewhat less than that of a commercial management consulting firm.

<bullet> Timeliness. The NRC study process, which includes commissioning and contracting for the study, selecting and convening a study committee, arranging subsequent meetings among busy experts who are often in high demand and serving on a volunteer basis, and navigating a report through peer review, editing, production, and release takes time. The average (with a very wide variance) duration of an NRC study is about 18 months, but can be longer, especially for controversial topics. Congressionally mandated studies involve additional complications as well (discussed below). It should also be noted, however, that studies can also be carried out quite rapidly given an important national need. Making the Nation Safer, noted above, was completed in six months. Another widely cited study, Climate Change Science, was completed in one month and the recently completed report, Rising Above the Gathering Storm, noted earlier was completed in six months.

<bullet> Sources of Sponsorship. Most NRC studies are commissioned and paid for by federal agencies through contracts (at least one per study undertaken and sometimes many contracts per study from multiple agencies). Studies are funded from other sources as well (sometimes in addition to federal agency sponsorship), such as foundations or even limited sponsorship from private sector sponsors or even States. Studies mandated by Congress also require the additional hurdle of enacting a federal law directing an agency to contract with the NRC. On the one hand, the practice of negotiating studies individually, whether there are multiple sponsors or not, is beneficial in that it can help ensure that the studies the NRC undertakes are relevant and important. Also the diversity of financial sponsorship for a large portfolio of studies from many executive agencies (see Figure 1) helps assure independence, especially by minimizing the dependence of the NRC's financial support on any one federal source. On the other hand, it often takes six to nine months through a government procurement process to initiate an NRC study even after a mandated study has been enacted in law (or included in the legislative report language accompanying passage of the law). For those studies mandated by Congress, yet an additional delay often results from the time needed to implement the legislation. While it has been sometimes suggested that the Academies consider requesting an annual appropriation of funds from Congress (probably executed as a task order contract with a relevant federal agency) to facilitate improved administrative efficiency in carrying out studies (e.g., reducing the time for securing individual contracts for studies), the Academies' leadership has historically been unwilling to consider this option, since such an arrangement could lead to compromises in institutional independence.

<bullet> Committee Authorship. NRC study committees of

experts, widely considered to be a key strength of the NRC study approach, include widely respected individuals from academia, industry, and essentially all groups relevant to the study committee's charge. However, the volunteer committee of experts as authors of the report can also sometimes be a weakness. For example, NRC committees are made up of distinguished volunteers who have many other responsibilities in their professional lives. Without careful oversight by the committee chair and sometimes NRC management, committee members with the most at stake in a study or perhaps with the most available time to commit to the effort could have a disproportionate influence over a study's deliberations and outcomes. This is why the NRC places such a high priority on recruiting strong chairs, providing experienced professional support staff in managing committees, and executing rigorous procedures for identifying and addressing potential bias and conflicts of interest of prospective committee members. Committee members who attempt to abuse their responsibilities as committee members can be removed while a study is under way.

A CURRENT GAP IN ADVICE TUNED TO CONGRESSIONAL NEEDS

As just outlined, the NRC study process is well developed and serves one important need of Congress--providing an authoritative recommendation from widely recognized experts on a specific course of action. In particular, NRC committees are usually assembled with the intention of achieving consensus recommendations supported by evidence and subject to rigorous peer review. In a very controversial subject area with scientific and other uncertainties, if a broad set of perspectives are included in the study committee a consensus might be difficult to achieve, particularly if the purpose is to include all possible scientific and other perspectives on a problem or if complex policy considerations are involved. This is why the NRC places a high priority on an appropriately balanced committee and a rigorous information-gathering phase of a committee's work, where such perspectives can be heard and considered by the committee.\12\

\12\ While NRC study committees strive by design to produce consensus findings and recommendations, academy policies and procedures do provide for publishing dissenting views when consensus cannot be achieved.

Since the historical focus of the NRC process has been on delivering consensus-based advice, the process as it has evolved is less well equipped to elaborate on the broader context of an issue and inform the policy debate with careful and objective analysis of the policy consequences of alternative courses of action, especially those that may involve value judgments and social or economic trade-offs beyond the scope of technical analysis. Consequently, it has been less common for the NRC to assemble committees charged with identifying and evaluating the pros and cons of a range of alternative policy options, although such committees are sometimes created and it would certainly be possible to develop such a study process to be used more widely at the National Academies.

Both types of analysis just described are important to congressional deliberation depending upon the circumstances. With the closure of the former OTA, organizations focused on the latter type of

analysis, either performed by a disinterested analytical organization within the Congress itself or readily accessible to the Congress from an external organization, do not currently exist and may at some point need to be reconstructed, perhaps involving the National Academies in some way.

Example: The Future of the U.S. Electric Power System

As an example illustrating the analysis gap just noted, consider the case where the U.S. Congress may be interested in the future of the electric power system following a major blackout. The salient issues could be posed in two alternative ways:

<bullet> One type of study would be to seek an authoritative set of recommendations for making the system more secure and reliable. In such a study, the well established NRC approach would be to assemble a committee of widely recognized experts. The Committee would review what is known about the power system and currently expected paths of continued development and then prepare specific engineering, technology and operational recommendations about how to improve system reliability and performance. Indeed, such a study is currently underway at the NRC sponsored by the new U.S. Department of Homeland Security.

<bullet> In another type of study, Congress might be interested in exploring the technical as well as societal, environmental, economic, regulatory, or other broad implications of alternative scenarios of increasing competition in the Nation's electric utility industry, perhaps once again precipitated by a blackout widely perceived, correctly or not, to be the result of deregulation. Not only technical, but also political, economic, social, environmental, and probably many other kinds of tradeoffs and value judgments are involved in characterizing a series of scenarios for the future structure of the industry, ranging from moving toward a national centrally controlled electric supply grid to fully deregulating wholesale and retail electricity segments of the industry.

In the latter case a definitive set of consensus recommendations is not the objective, and the collection of stakeholders and experts necessary to carefully identify and explore these alternatives would be considerably different than for the study committee structured to reach fact-based, tightly reasoned consensus recommendations based on scientific evidence and on specific technical issues. Rather, the objective would be to articulate the implications of alternative scenarios and accompanying policy decisions, usually at a higher level of abstraction than the former case.

In short, and perhaps at the risk of being simplistic, the first type of analysis is designed to illuminate the scientific and technical aspects of a problem to help direct a specific course of action while, in the second case, the analysis is designed principally to inform the debate, including perspectives that may go beyond science and engineering. Both types of analysis are very important to Congressional deliberations. The contrasts between these two types of analysis are discussed below in a more detailed comparison of the NRC process with that of the former OTA. As noted above, the fact that the NRC process does not now generally accommodate this second form of advice does not

mean that it could not; the NRC often considers and implements changes in its processes in response to government needs, although going beyond the tradition of fact-based studies with a science and technology focus to more policy-oriented studies could pose risks to the NRC's credibility so such changes would have to be implemented very carefully.

Real-Time Advice: A Continuing Imperative

As a case in point of the evolution of NRC processes, the horrific terrorist events of September 11, 2001 in the United State spurred widespread interest in finding ways to contribute to the understanding of the science and technology dimensions of homeland security and countering terrorism. Specifically, many government agencies expressed urgent needs for immediate advice in these areas. In response, the NRC experimented with using its convening power to assemble small groups of experts who then provided advice as individuals, rather than as a group constituting an NRC committee. Such ``real-time'' advice, which does not result in a written report and does not carry the imprimatur of the NRC process (especially the quality control aspects of committee deliberation and peer review of a written report) does not constitute formal advice of the Academy to government. It has, however, provided a new means of satisfying a real government need, i.e., providing timely input to policy-makers and other organizations, including, as an example, a standing arrangement with the Government Accountability Office (GAO), an agency of the Congress, discussed further below.

Additional Congressional needs vary widely, including such deliverables as (1) ``instant education'' on a complex science and technology issue, (2) ``translations'' of authoritative technical reports to more readable and understandable language tuned to the needs of policy-makers with very broad responsibilities, (3) summaries of landmark authoritative reports, and (4) updates or adaptations of existing reports and information to current needs, and (5) readily available and trusted expert consultants on call to help with quick turnaround questions and interpretations of complex technical information. Some of these capabilities are accessible to the Congress to varying degrees through the Congressional Research Service, but others, especially (1) and (5) are not currently generally available to the Congress, at least in any organized or readily accessible way by an organization directly accountable to Congress.

Collaboration and the GAO Experiment

In an experiment referenced above to test the feasibility of developing a ``technology assessment'' capability in another Congressional support agency, the Government Accountability Office (GAO), a first-of-a-kind GAO technology assessment report on biometric technologies was released in 2002.\13\ While the NRC was not involved in developing this assessment, it was asked to use its contacts to assist the GAO in identifying individuals with the proper expertise. In retrospect, there are a number of shortcomings in the approach adopted by the GAO in carrying out its first attempt at a technology assessment, most notably the lack of a substantive and accountable peer review process, but the experiment was more successful than many anticipated and the GAO seems receptive to incorporating improvements suggested by a group commissioned to review the GAO approach (see Fri et al., 2002). In particular, the group identified a number of

significant organizational challenges that it felt were necessary to refine the GAO approach, which could then possibly evolve into a more mature technology assessment capability within the legislative branch of government. The GAO technology assessment experiment is continuing at a modest scale of one to two assessments annually on selected topics.

\13\ Since 1996 members of Congress at various times have proposed experiments to fill the perceived gap in science and technology advice in the wake of closure of the OTA, including attempts to simply resurrect the agency; see Jones (2004) and Knezo (2005). One such experiment that has come to pass is creation of a ``pilot'' technology assessment capability in the Government Accountability Office, a support agency of the Congress. The first such assessment (GAO, 2002), was released in November 2002.

Whether the GAO is ultimately capable of the reforms identified by the independent review panel remains to be seen, but it seems fair to conclude that the initial GAO experiment has yielded evidence sufficient to continue the experiment. The NRC's modest role in this experiment, by convening groups of experts to talk with GAO study teams, appears to have been one of the successful features of this approach and may constitute one way in which the National Academies can contribute to a renewed technology assessment capability within the legislative branch, in addition to its more traditional response to congressionally mandated requests for assistance. The NRC's relationship with GAO also includes, more generally, a standing arrangement to assemble experts to talk with GAO staff on a specific set of technical issues relevant to ongoing GAO studies. Such a mechanism provides the GAO a degree of access to the National Academies' considerable network of technical experts.

THE FORMER OFFICE OF TECHNOLOGY ASSESSMENT

The GAO experiment was designed to help fill the gap in science and technology advice for Congressional needs left by closure of OTA. By comparison and contrast with the NRC study process, the OTA study process used an authoritative committee of volunteers as an advisory panel rather than in the role of assuming authorship of the study itself. The study report was, instead, produced by professional staff subject to external review. On one hand, this approach permitted easier regulation of the role of the committee, particular if achieving a consensus in a broad controversial area was unlikely, but, on the other hand, such a practice also sacrificed the authoritativeness of the ``best and brightest'' volunteer experts identified as authors of the report, an important feature of the NRC process.

Because the former OTA panels were advisory, and not the report's authors, the necessity of reaching a consensus was seldom an issue. Indeed, OTA was prohibited in its enabling legislation from making recommendations, so the panel was created to try to collect the views of all important stakeholders rather than to try to produce consensus recommendations. This sometimes resulted in a frustrating experience for panelists serving on OTA advisory panels who were eager to offer specific recommendations. Instead, OTA project teams sought to analyze and articulate the consequences of alternative courses of action and elaborate on the context of a problem without coming to consensus recommendations on a specific course of action, which would be

difficult anyway with a diverse group with points of view that prevented consensus on many controversial issues. In the later years of the agency's existence OTA reports included more and more specific findings as a carefully developed alternative to recommendations.

If required to deliver a consensus set of recommendations, even if it were permitted under the enabling legislation, the former OTA model would likely be unworkable for controversial subjects with many opposing points of view. Nonetheless, the type of study undertaken by the former OTA was an important input to Congressional deliberation and it has not yet been reproduced in the Legislative Branch agencies or elsewhere, including the National Academies. The Academies could probably carry out more such studies but that would likely require some significant changes in its study procedures to accommodate such studies as indicated above and in more detail below.

OTA's Organizational Structure

OTA operated under Congressional authorization provided in the Technology Assessment Act of 1972 and funds were appropriated in 1973 to begin operations in 1974 with a handful of staff that grew to 200 in the later years of the agency's existence. The staff structure included a core permanent staff of 143 that was supplemented with temporary staff recruited to meet the needs of current assessments. Both permanent and temporary staff included professionals from many disciplines, over half with Ph.D.s. OTA produced on average 32 reports per year over its history and 51 reports per year in its last three years of its existence.\14\

\14\ The entire collection of OTA assessments delivered during the agency's history (1972-1995) is preserved electronically and available at <http://www.wws.princeton.edu/ota/> and on a CD-ROM collection (Office of Technology Assessment, 1996).

The key organizational elements created in OTA's enabling statute were (1) the Technology Assessment Board (TAB) composed of members of both chambers of the U.S. Congress, the House of Representatives and Senate; (2) a Technology Assessment Advisory Council (TAAC), composed primarily of private citizens appointed by TAB; and (3) the Office of the Director, which oversaw day-to-day operations of the agency.

<bullet> Technology Assessment Board. TAB was the central organizational element articulated in OTA's enabling statute with its composition unique among the legislative support agencies.\15\ TAB was a 12-member governing board of OTA, with six members of the Senate and six of the House of Representatives, divided equally between the two dominant U.S. political parties. The principal responsibilities of TAB were to appoint the Director, to authorize the initiation of assessments requested by Congressional Committees, to approve the budget authority associated with those assessments, and finally to authorize delivery of assessment reports to requesting committees and the public by certifying that OTA has carried out its assessment process faithfully, i.e., that OTA had considered all the relevant stakeholder interests and issues and undergone extensive external review. OTA received an annual budget appropriation from Congress allocated to OTA's support operations and among OTA active projects as authorized

by TAB.

\15\ During OTA's existence, there were four Congressional analytical support agencies: the Library of Congress's Congressional Research Service (CRS), the General Accounting Office (GAO) [GAO's name was changed to the Government Accountability Office in 2004], and the Congressional Budget Office (CBO). CRS, GAO, and CBO remain in operation today.

<bullet> Technology Assessment Advisory Council. TAAC was essentially OTA's outside visiting committee. It was appointed by TAB and met periodically to review the overall direction of the agency and carry out more detailed reviews of the agency's

research programs.

<bullet> Office of the Director. The OTA Director was responsible for day-to-day operations, hiring and management of staff, interaction with TAB and TAAC, and strategic planning for and organization of the agency.

OTA's Process of Technology Assessment\16\

\16\ OTA's assessment process is documented widely in the literature, including Guston (2003), Bimber (1996), and many others.

As noted above, OTA generally undertook assessments at the request of the Chairs of Congressional Committees. Typical OTA assessments took 18-24 months to complete and cost on the order of \$500,000 (1996 dollars) in direct costs (although indirect costs essentially doubled the total cost).\17\ OTA assessments seldom offered specific recommendations. Rather, they articulated policy options and the consequences of alternative options.

\17\ As noted earlier, OTA delivered on average 51 reports per year during the last three years of the agency's existence.

A great deal of effort went into defining the scope of an assessment once it was requested by a Committee Chair. Since OTA frequently received many more requests than it could accommodate, the project directors often consulted with other congressional committees of jurisdiction and interest as well as with the TAB informally to help establish study priorities fairly. Once a general study scope was established, a proposal was prepared for formal consideration by TAB and, if approved, the assessment commenced. The portfolio of assessments addressed a broad range of subjects on the Congressional agenda, such as energy and environmental technology issues, proliferation of weapons of mass destruction, global telecommunications policy, biological pest control, and health care reform. The key elements of an assessment typically were the following:

<bullet> a comprehensive advisory panel of technical experts and relevant stakeholders;

<bullet> a core OTA project team including an experienced project director;

<bullet> contractors and consultants selected to support major analytical tasks;

<bullet> in-house research efforts by the project team;

<bullet> workshops convened with additional experts and stakeholders to obtain the most current information possible;

<bullet> extensive review and comment of draft reports by external technical experts and stakeholder interests;

<bullet> and, finally, delivery of reports through congressional hearings, briefings, and public release, and often considerable follow-up consultation with requesting congressional committees of jurisdiction and interest.

OTA advisory panels were an important feature of OTA's assessment process. They helped refine the project scope, identified additional relevant resources and perspectives on the issues being addressed, and provided the core of extensive peer review. The advisory panel was central, but OTA took responsibility for the final product. The agency did not seek consensus from the panel because most often if there were a possible consensus decision or course of action, OTA probably wouldn't have been asked to do the study in the first place. The principal final product of an OTA assessment was a report, along with summaries, report briefs, personal briefings for members and committees, commercial publishers' reprints, and in the final years of the agency's existence electronic delivery of these products over the Internet and via Capitol Hill's local area network.

At the highest level of abstraction, the OTA assessment process is similar to the NRC study process in that it also can also be defined in terms of a sequence of five major stages similar to those of the NRC process. However, each stage has significant differences in their details compared with the corresponding stages in the NRC process. The stages to the OTA process were the following: (1) project selection, (2) project planning and preparation, (3) project execution: data collection, analysis, and report preparation, (4) report review, delivery and publication, and (5) report dissemination, use and follow-up activities.

STAGE 1: Project Selection

OTA worked principally for the Committees of the U.S. Congress, and, hence, projects were generally initiated as a result of inquiries from Congressional committee staff ultimately resulting in formal letters of request from Committee Chairs and ranking members (and often from more than one committee of jurisdiction or interest). Projects could also on occasion be initiated at the request of TAB or by the OTA Director with TAB's approval, although such studies were rare. In practice, OTA staff became what former TAB Chair Senator Ted Stevens referred to as ``shared staff'' for standing House and Senate Committees and studies were often initiated as a result of ongoing interaction between Congressional Committee staff and OTA staff.

A great deal of preliminary work often went into the planning for a new OTA assessment. Usually this work involved preliminary data collection and literature research, including reviewing relevant legislative history, congressional committee hearings and reports, and

reports from other Congressional agencies (CBO, CRS, and GAO), all to help frame the issues for the project proposal and work plan. The major product at this stage in the assessment process was a proposal which first was approved internally by the OTA Director for consideration by TAB for review and approval. The proposal included a detailed work plan and budget proposal, and, if approved by TAB, resources would be set aside out of OTA's annual appropriation to carry out the assessment.

STAGE 2: Project Planning and Preparation

Following TAB approval, a project team of two to six professional staff was appointed. Usually the project director was a permanent staff member with experience in prior OTA assessments supplemented with additional senior and junior staff members who were either permanent staff or rotational (temporary) staff recruited for specialized skills needed to carry out the assessment. Overall, the research and writing of OTA assessments was principally conducted by a staff of about 200, of which two-thirds were the professional research staff. In the early 1990s, among the research staff, 88 percent had advanced degrees, 58 percent with Ph.D.s, primarily in the physical, life, and social sciences, economics, and engineering. About 40 percent of the research staff were temporary appointments of professionals recruited specifically to staff ongoing assessments. For specific information or analysis, OTA also contracted with key individuals or organizations. Contractors analyzed data, conducted case studies, and otherwise provided expertise to complement staff capability.

The project team assembled a slate of nominees for the project's advisory panel by defining the major stakeholder interests in the issues to be addressed, the important science and technology expertise relevant to the assessment, and other interests as necessary to capture a very broad range of perspectives on the study scope. The advisory panel slate was submitted for approval through OTA management and ultimately approved by the Director, often with revisions or additions to the originally proposed slate. The project team organized and commissioned the portfolio of contractor support tasks, assigned internal analysis tasks, information gathering workshops, and other activities as specified in the work plan.

STAGE 3: Execution: Data Collection Analysis and Report Preparation

Carrying out the assessment itself was typically organized around meetings of the project's advisory panel. The panel's principal responsibility was to ensure that reports were objective, fair, and authoritative by helping to shape studies in the early stages by suggesting alternative approaches, reviewing documents throughout the course of the assessment, and critiquing reports at the final stages. The panels typically met three times during a study, initially to help frame the study, second as an opportunity to effect "mid-course corrections" and, finally, as the point of departure for the initial and perhaps most important part of peer review of the draft report.

In addition to the advisory panel, many others assisted with OTA assessments through participation in technical workshops, provision of background information, and review of documents. Commissioned contractor reports, invited papers contributed to workshops, internal working papers prepared by professional staff, and interaction with parallel studies on-going in other organizations all helped shape the body of information considered as the staff began to prepare the assessment report. In all, nearly 5,000 outside panelists and workshop participants came to OTA annually to help OTA in its work.

The role of contractors in an OTA assessment evolved considerably over the agency's history. In the early years commissioning external contracts were perhaps the dominant part of a study. Over the years as the agency's professional staff developed and became much more attuned to Congressional needs, contractors were used less, but were often an important part of an OTA assessment.

STAGE 4: Report Review Delivery and Public Release

OTA placed a very high premium on clearly written reports that effectively communicated very complex topics to Congressional staff and the public. This involved writing reports specifically tuned to Congressional needs, such as language suitable for and relevant to broad policy discussions, extensive examples, and illustrative anecdotes helpful for framing policy debates. Also, as noted earlier, no attempt was made to develop a consensus among panel members; in fact, a wide diversity of views was sought. OTA retained full responsibility for the content and conclusions of each report. OTA draft assessment reports went through extensive formal review and revision conducted by OTA staff and outside experts. Some outside reviewers examined portions of the report while others the entire report and the total number of reviewers involved often exceeded 100 individuals.

Accompanying a final draft report for consideration by the Director was a ``response to review'' memorandum prepared by the project director that reviewed all comments received on the draft report and how they were dealt with in producing the final draft report. Upon the Director's approval of the final draft assessment report and its response-to-review, copies of the final report were sent to TAB for its review and authorization for publication. If approved by TAB, published reports were then forwarded to the requesting committee or committees, summaries and one-page report briefs were sent to all Members of Congress, and then the report was released to the public. OTA assessments were published by the Government Printing Office and were frequently reprinted by commercial publishers.

STAGE 5: Dissemination Use and Follow-up

Upon delivery of a published OTA assessment report to sponsors and public release, frequently congressional hearings and briefings followed. Reports were disseminated widely to the relevant policy communities, and frequently OTA staff prepared publications based on the report for peer reviewed journals or other publications. OTA reports were often reprinted by commercial publishers (as a government-produced document, OTA reports carried no copyright), and in the final years of the agency's existence electronic delivery over the Internet and via Capitol Hill's local area network became standard practice. Finally, senior OTA staff involved in the effort often became subject matter experts called upon frequently by congressional staff and members as legislative initiatives were considered in the subject area addressed by the assessment. As noted earlier Senator Ted Stevens often referred to OTA project teams as ``shared staff' experts in science and technology supporting congressional committee staffs where such expertise was often scarce.

THE NRC AND OTA STUDY PROCESSES COMPARED

Some of the differences between the NRC and OTA study processes as they relate to studies requested by Congress have already been noted

and in some ways the processes are more similar than they are different (see Figure 2). Both involve a carefully bounded and defined scope of work culminating in a formal study request, usually in the form of a letter or congressional legislation. In both cases the scope of work is formally documented with a proposal and work plan, although in the case of the NRC the proposal takes the form both of an internal study prospectus to be approved by the NRC Governing Board\18\ as well as an external contract proposal to formalize the funding sources with the sponsoring federal agencies (or sometimes other organizations). In the OTA case, the TAB authorized approval of expenditures for the study against the agency's annual appropriation. The mechanism of project funding is one of the fundamental differences between the two approaches (discussed more below), but there are many other differences as well.

\18\ Technically, this approval is delegated by the Governing Board (which meets quarterly) to its Executive Committee (which meets monthly).

Role of Volunteer Committee

The role, purpose and even composition of study committees in the NRC case and advisory panels in the OTA case are quite different in several respects, some of which were noted above. In the NRC case the committee assumes authorship of the report while in the OTA case the committee is advisory to professional staff who draft the report. The quality of the study in the NRC case is much more dependent upon quality of the committee recruited to carry it out, which explains why considerable effort is spent on recruiting high quality committees for NRC studies. Such was the case for recruiting OTA advisory panels as well, but the success of the study was relatively less dependent on the role of the advisory panel.

The quality of the staff project team was the dominant consideration in the OTA case. As noted above, members serve pro bono on NRC committees while in the OTA case a modest honoraria for service by advisory panel members was occasionally provided. NRC committees are generally recruited with the intention of coming to a consensus regarding findings, conclusions, and recommendations included in the committee's report. In the OTA case the goal was instead to have all legitimate interests in the policy area under study represented on the advisory panel with no expectation of reaching a consensus view. Finally, because in the NRC case the committee assumed authorship of the report, elaborate institutional procedures for avoiding conflicts of interest are a high priority. In the OTA case, since the goal of the advisory committee was to include all legitimate interests, conflicts of interest were essentially encouraged, although carefully balanced in the committee composition.

Role of the Professional Staff

As a consequence of the differing roles and structure of NRC committees vs. OTA advisory panels, the roles of the professional staff in the study process are generally quite different as well. In the NRC case, the principal responsibilities of the staff are to plan, organize and structure the study, initiate selection of the study committee membership, and facilitate the committee's work, including ensuring

adherence to the policies and procedures established for NRC studies.\19\ However, as noted above, even though NRC committees assume authorship of the study report, in practice draft reports for the committee's critique and consensus are produced in a variety of ways, and frequently involve committee member drafting, committees critiquing drafts prepared by staff, and collaborative combinations of committee and staff authorship. In the OTA case the professional staff members planned and managed the assessment, and took responsibility for the report as the study authors. Finally, OTA staff were also Legislative Branch government employees with frequent day-to-day interaction with Congressional staff and Members before, during, and after completion of OTA assessments.

\19\ In practice the degree to which the NRC staff members are involved in drafting a committee report varies widely. In some studies staff members become very actively involved in the substance of the committee's work while in others staff principally facilitate the committee's work.

Requests to initiate studies

Most congressionally requested NRC studies require that the study be mandated in law or specified in a legislative report accompanying the law when passed by Congress. Otherwise it is unlikely that the relevant executive agency would be willing to provide the funding to support the study. On rare occasions, letters of request from Members of Congress lead to studies funded by internal resources of the National Academies. In the OTA case by far most studies were requested by Chairs and Ranking Members of standing committees of either or both chambers of the Congress, although studies were sometimes also mandated in law (although still subject to approval by TAB).

Funding of studies

Most NRC studies are funded by executive agencies through a sole-source (non-competitive) contract or grant or in some cases an individual task negotiated as part of a task order contract. Sometimes funds for congressionally mandated studies are provided in appropriations legislation. Often, though, mandated studies are specified in authorizing legislation or report language accompanying legislation and agencies may or may not choose to make funds available to carry out the study. In the OTA case, funds for virtually all studies were drawn from the agency's annual budget appropriation for the agency's operations and were allocated when the study proposal was approved by TAB.

Government Oversight of Policies and Procedures

As an independent, private, non-profit organization, many of the same laws that apply to such organizations apply to the National Academies, especially those related to, for example, employment practices or contracting and financial auditing requirements. In addition, special additional policies apply, such as Section 15 of the Federal Advisory Committee Act (see Appendix A) and several Presidential Executive Orders\20\ applicable to the National Academies charter and mission. So, while there are many government oversight

mechanisms that apply to specific individual academy policies and procedures, there is no direct overall oversight relationship with the government.

\20\ The NRC was included formally under the charter of the NAS with a Presidential Executive order signed by Woodrow Wilson in 1918 and reaffirmed and revised in 1956 and 1993 (see Executive Office of the President, 1993).

By contrast, as a Congressional agency, OTA had many fewer operational government oversight mechanisms while the agency had three direct oversight mechanisms within the Congress itself. (1) TAB, which was ultimately responsible for managing the agency, (2) the Senate and House Appropriations Committees where OTA's operating budget was established as part of the annual Legislative Branch appropriations process, and (3) standing committees of the House and Senate (Senate Committee on Governmental Affairs and the House Committee on Science) with responsibility for oversight of OTA's authorizing statute.\21\

\21\ Technically, OTA's authorizing statute, the Technology Assessment Act of 1972 (U.S. Code, Title 2, Chapter 15, Sections 471-481), was never repealed by Congress so the agency does not exist only because funds are no longer appropriated for its operations.

Government oversight of study scope

As noted above the mechanism for controlling a study's scope for an NRC study is the contract or grant with a federal executive agency responsible for the funds to sponsor the study. Sometimes differences between congressional expectations, as articulated in the legislative language mandating the study, and the contract language with the designated executive agency can be difficult to resolve to the satisfaction of all concerns. In the OTA case the mechanism for controlling the study scope was ultimately the responsibility of TAB.

Report peer review mechanisms

NRC reports are subjected to an independent and anonymous peer review process. That is, the study committee is obliged to respond to comments from peer reviewers whose identity is unknown to the committee until after the report is published. Reviewers are selected through a process overseen by the executive offices of the NRC's major program divisions and the Report Review Committee (RRC), which is a National Academies committee independent of all involved in preparation of the study report. Judgment of the adequacy of a committee's response to review is managed by the RRC. Typically 10-12 reviewers provide detailed comments on the draft report. In the OTA case, while there were as many as 100 reviewers engaged in reviewing parts or all of a draft OTA report, the reviewers were generally selected by the OTA project team but often supplemented with reviewers selected by senior OTA management. The OTA project director drafted the response to review subject to the approval of senior OTA management and ultimately TAB.

Nature of Reports

As noted above, NRC reports are usually designed to yield consensus

findings, conclusions, and recommendations from an authoritative committee regarding a specific course of action. OTA reports generally did not include specific recommendations but, rather, were designed to articulate the consequences of alternative options without selecting a preferred option, although, as noted earlier, in the later years of the agency's existence OTA reports included more and more specific findings as a carefully developed alternative to recommendations. It is perhaps important to note that in neither of the NRC or OTA cases is the intention of the study report to produce new technical understanding. Indeed, in both cases the intent is to collect and make understandable to broader audiences, particularly policy makers, established perspectives on the current understanding of the issue(s) under study.

Report Delivery and Dissemination

In most cases dissemination of NRC reports is limited to delivery to executive agency sponsors and relevant congressional committees and released to the public through the National Academies Press and made available on the National Academies Internet site. Often the report is initially released in a pre-publication draft format in order to effect as timely as possible delivery of the information to the sponsoring agency and the public. The final printed report, including editorial but no substantive changes to the report content, follows later as published by the National Academies Press (NAP) and made available on the academy Internet site. The National Academies holds the copyright on the report and the NAP offers copies of most reports for sale to the public and all reports available without charge on the academy Internet site. Occasionally, the committee chair and some committee members participate in agency or congressional briefings of the report or provide testimony for congressional hearings. OTA reports, along with accompanying summaries and report briefs, were widely distributed upon public release and were available for sale through the Superintendent of Documents (Government Printing Office) and made available without charge on the agency's Internet site. OTA staff frequently provided congressional briefings and testimony and occasionally executive agency briefings as well as often preparing papers and summaries based on the report for the peer reviewed literature.

Follow-up Activities

For the most part, when NRC reports are delivered to sponsors and publicly released, the committee's work is largely over, except for dissemination activities noted above. Occasionally committees are reconvened for follow-up studies or committees are empanelled in the first place with the intention of producing a series of reports, such as an annual review of a Federal R&D program over a period of years. In the OTA case, initial report dissemination activities were similar to the NRC routine, but with much more focus on the Congressional audience, as one might expect. However, it was also very common for smaller scale follow-up background papers on topics included in the assessment to be requested by Congressional committees. In addition, OTA staff members were consulted frequently by congressional committee staff on an ongoing basis in areas where OTA assessments had been completed, often for many years following the completion of a major assessment.

CONCLUSIONS

The reputation of the National Academies as a trusted source of advice for government on science and technology issues is due not only to the quality of expertise the NRC is able to involve in its work but also to the highly structured process guiding NRC studies that has evolved steadily over many years. The goal of this process, which includes many features of quality control and assurance relating both the process by which the advice is generated and the report documenting that advice, is to maintain balance and objectivity throughout a committee's work and to produce reports considered to be both unbiased and authoritative.

The National Academies have enjoyed a longstanding and effective working relationship with Congress on even the most controversial issues. There are, no doubt, many characteristics of that relationship that could be improved, both to perform the traditional NRC role more effectively and to provide some opportunities to expand that role. However, effective science advice in the unique policy making environment of the Congress is a complex undertaking (see Smith and Stine, 2003). There are a variety of options for filling the gap in analysis capabilities left in the wake of the closure of OTA, some of which might involve the National Academies (see Morgan and Peha, 2003).

Many features of the OTA assessment process were similar to those used currently by the NRC, but as outlined in this paper, there are fundamental differences as well. The OTA process was well suited to a broad policy context, paralleling that of congressional deliberation, where the questions involve the relationship of science and technology to broader economic, environmental, social and other policy issues where many legitimate courses of policy action are possible and any consensus view with all stakeholder views represented is most unlikely.\22\

\22\ The reasons Congressional leadership gave for closing OTA in 1995 were not so much related to the quality of the advice the agency provided to Congress but to the timeliness of its delivery; see Walker (2001) and Dawson (2001).

As an example of this contrast between the two approaches (illustrated also by the electric utility industry case described earlier), consider the case of federal policy on fuel economy regulation of automobiles. In the early 1990s both the OTA and the NRC were asked to consider the subject of improving automotive fuel economy and, more specifically, the feasibility of increasing fuel economy standards to achieve better fuel efficiency in the Nation's auto fleet. The OTA report elaborates on the various trade-offs associated with raising standards versus alternative policy mechanisms for achieving automotive improved fuel economy (OTA, 1991). The NRC study (1992) much more specifically comes to conclusions regarding the technical feasibility of various proposed standards and provides a specific recommendation on a particular set of standards that, in the opinion of the committee, is technically feasible while having minimal or at least acceptable market disruption. The NRC deliverable required that a committee of experts reach a consensus and the recommendations are widely considered authoritative. The OTA study could seek consensus on facts and analysis (although the process did not require it because the panel of experts was advisory), but it did not come to a specific recommendations regarding the standards, partly because the agency's charter precluded coming to a specific recommendation in the first

place and partly because the advisory panel was assembled with the broadest range of stakeholders and would likely not have been able to reach consensus anyway.

OTA-like Features Emerging in the NRC Study Process

It is interesting to note that in 2002 the NRC issued a new report on fuel economy standards (NRC, 2002) where alternative mechanisms for achieving improved U.S. automotive fuel economy were addressed, moving in the direction of an OTA assessment, although by far the most referenced portions of that report remain the identification and evaluation of the technical potential for improving fuel economy. In another more recent case, the academy report, *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (NRC, 2005), is very similar in scope to an OTA assessment with the added benefits of a highly prestigious committee identified as authors of the report and very specific recommendations offered.

Although not carrying the 100-year-old imprimatur of the National Academies, OTA's reports developed a reputation for being authoritative as well, but OTA's strength was more, as the late George Brown, once Chair of the TAB and of the House Science Committee, put it, a ``defense against the dumb'' by elaborating on the context of an issue and informing the debate with careful analysis of the consequences of alternative courses of action without coming to a recommendation of a specific course of action, which often involved value judgments and trade-offs beyond the scope of the OTA analysis.

As noted earlier, both types of analysis just described are important to congressional deliberation depending upon the circumstances, but with the closure of the former OTA, the latter type of analysis neither exists within the Congress itself nor is readily accessible to the Congress. The ``OTA style'' of analysis could be very useful for many executive agency needs as well.

Some OTA-like features have evolved over time with NRC studies. For example, the IOM\23\ now increasingly hires staff for new studies who are recognized experts themselves in a particular area to work on studies and who consequently take a more active role than was the previous custom in drafting the committee report. This method can increase the already high cost of doing NRC studies, but it has the benefit of increasing the capacity of the study committee to assemble background information efficiently, both as a basis for deliberation and for providing background documentation for the report that would likely not have been included. That is, the report now has more information that can be used both to inform the ultimate decision of the sponsor and to help rationalize the recommendations of the study committee in a more comprehensive manner. Additional OTA-like features are certainly possible at the National Academies, and in some cases such features are already being introduced, but many internal and external control issues outlined in this paper would have to be resolved for the NRC to incorporate many features of the role OTA played on Capitol Hill.

\23\ The IOM administers a collection of program activities that operate under NRC policies and procedures, although formally they are not part of the NRC.

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<GRAPHIC(S) NOT AVAILABLE IN TIFF FORMAT>

APPENDIX A:

Section 15 as amended of the Federal Advisory Committee Act

(Public Law 105-153, 105th Congress, Approved December 17, 1997)

(a) IN GENERAL.--An agency may not use any advice or recommendation provided by the National Academy of Sciences or National Academy of Public Administration that was developed by use of a committee created by that academy under an agreement with an agency, unless--

(1) the committee was not subject to any actual management or control by an agency or an officer of the Federal Government;

(2) in the case of a committee created after the date of enactment of the Federal Advisory Committee Act Amendments of 1997, the membership of the committee was appointed in accordance with the requirements described in subsection (b)(1); and

(3) in developing the advice or recommendation, the academy complied with--

(A) subsection (b)(2) through (6), in the case of any advice or recommendation provided by the National Academy of Sciences; or

(B) subsection (b)(2) and (5), in the case of any advice or recommendation provided by the National Academy of Public Administration.

(b) REQUIREMENTS--The requirements referred to in subsection (a) are as follows:

(1) The Academy shall determine and provide public notice of the names and brief biographies of individuals that the Academy appoints or intends to appoint to serve on the committee. The Academy shall determine and provide a reasonable opportunity for the public to comment on such appointments before they are made or, if the Academy determines such prior comment is not practicable, in the period immediately following the appointments. The Academy shall make its best efforts to ensure that (A) no individual appointed to serve on the committee has a conflict of interest that is relevant to the functions to be performed, unless such conflict is promptly and publicly disclosed and the Academy determines that the conflict is unavoidable, (B) the committee membership is fairly balanced as determined by the Academy to be appropriate for the functions

to be performed, and (C) the final report of the Academy will be the result of the Academy's independent judgment. The Academy shall require that individuals that the Academy appoints or intends to appoint to serve on the committee inform the Academy of the individual's conflicts of interest that are relevant to the functions to be performed.

(2) The Academy shall determine and provide public notice of committee meetings that will be open to the public.

(3) The Academy shall ensure that meetings of the committee to gather data from individuals who are not officials, agents, or employees of the Academy are open to the public, unless the Academy determines that a meeting would disclose matters described in section 552(b) of title 5, United States Code. The Academy shall make available to the public, at reasonable charge if appropriate, written materials presented to the committee by individuals who are not officials, agents, or employees of the Academy, unless the Academy determines that making material available would disclose matters described in that section.

(4) The Academy shall make available to the public as soon as practicable, at reasonable charge if appropriate, a brief summary of any committee meeting that is not a data gathering meeting, unless the Academy determines that the summary would disclose matters described in section 552(b) of title 5, United States Code. The summary shall identify the committee members present, the topics discussed, materials made available to the committee, and such other matters that the Academy determines should be included.

(5) The Academy shall make available to the public its final report, at reasonable charge if appropriate, unless the Academy determines that the report would disclose matters described in section 552(b) of title 5, United States Code. If the Academy determines that the report would disclose matters described in that section, the Academy shall make public an abbreviated version of the report that does not disclose those matters.

(6) After publication of the final report, the Academy shall make publicly available the names of the principal reviewers who reviewed the report in draft form and who are not officials, agents, or employees of the Academy.

(c) REGULATIONS--The Administrator of General Services may issue regulations implementing this section.

Note on Prior Provisions: A prior section 15 of the Federal Advisory Committee Act was renumbered section 16 by Pub. L. 105-153.

Accompanying Legislative Report

Section 3 of Pub. L. 105-153 provided that: ``Not later than one year after the date of the enactment of this Act [Dec. 17, 1997], the Administrator of General Services shall submit a report to the Congress on the implementation of and compliance with the amendments made by

this Act [enacting this section, amending section 3 of Pub. L. 92-463, set out in this Appendix, and redesignating former section 15 of Pub. L. 92-463, set out in this Appendix, as section 16].''