Rationalizing the National S&T Policy Mess

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Image credit: CReST Blog.

It is important that the nation enacts sound policies, whether the issues are impacted by science and technology (S&T), or whether the policy impacts S&T development. Yet, national policymaking with respect to S&T are spread out among numerous federal, state, and private agencies and organizations. There is no one in charge, and no consensus on who speaks for which issues and at what level specific technology issues should be addressed. Even as S&T moves more quickly and becomes more complex, processes to formulate and maintain policies remain problematic. The author describes the mess that is our national S&T policy apparatus, and suggests the creation of an Office of Science Policy.

In 2003 the Potomac Institute for Policy Studies proposed a study to continue its earlier examinations of the status of selected areas of science and technology research in the US and abroad, projecting where this research might lead and how its products could affect national security. Numerous agencies and organizations sponsored the study.[1] Its overarching goal was to suggest ways to improve the quality of S&T information involved in decisions made, or directly influenced, at the "highest levels" of government.

The study's output fell into two subject matter areas, S&T trends and impacts, and implications on the processes of creating technical policy in the US. Communication of this output was accomplished through a final report,[2] briefings presented to sponsors and industry; an article for the Review of Policy Research (RPR);[3] and a presentation and published proceedings at the Policy Research for Science and Technology (PREST) conference at the University of Manchester in the UK.[4]

This article updates and illustrates by examples those portions of the study's final report that involved creating technical policy in the US. We will discuss the broader structural issues that arise whenever any science and technology topic confronts policy-making individuals and organizations. In particular, we wish to reexamine the questions:

- How are national S&T policies created currently?
- What are the general weaknesses of today's S&T policymaking?
- What are some ways to build on the strengths and mitigate the weaknesses in national policymaking and management?

For the third question, we will make the bold recommendation of forming a new national agency, and consider its potential impact through three selected case studies.

The need to continually improve our ability to create and maintain good S&T policy is crucial and should begin by clearly and factually defining the technical aspects of the issues being addressed, even as we consider their moral, ethical, social, and political aspects. This is especially vital because of the continuation of three indisputable trends: The increasing rate of breakthroughs in science, the decreasing time between these breakthroughs and their application, and the growing impact of these products of science on our lives. The first two trends may often work to our advantage, but technology can produce unfortunate as well as beneficial impacts on society. The rise of drug resistant diseases in response to overuse of antibiotics, the threat of global climate change brought on by the broad proliferation of fossil fuel technologies, and the weaponization of increasingly deadly gases are illustrative. Could current research programs, such as nanotechnology and genome research produce similar dangers? Under the best circumstances predicting tragic unintended consequences of technology is difficult, but failing to take the time to think through their possible downsides can dramatically increase the chances of things going wrong. The last trend, which involves such basic elements as national security, economics and competitiveness with foreign research, is treated more holistically in the final report of the original study and the RPR article.

Unfortunately, the reality is that too often the political content of the decision process dominates and accelerates decisions and policies. And, broad issues are often addressed in narrow terms because of political expediencies or disagreements, or simply because of inadequate technical understanding by the policy-makers. The result is that while political aspects of science-laden issues are laboriously considered, even the foundational scientific arguments are frequently ignored.

A recent confrontation between Rep. Lamar Smith, Chair of the House Committee on Science, Space and Technology, and scientists at the National Oceanic and Atmospheric Administration (NOAA) demonstrates this point. The issue is over a study published by scientists at NOAA that contradicts assertions that global temperatures have held steady for the past several years, a thesis that has encouraged skepticism of climate change by Rep. Smith and others. The difference of opinion is important since policies based on a monotonic rise in Earth's average temperature would tend to prescribe stronger preventative measures than those that assume fluctuation or pause in warming trends.

Rep. Smith has threatened to subpoena the authors of the study, while seven scientific organizations, including the Association for the Advancement of Science, have accused him of "establishing a practice of inquests." Rep. Smith has charged that the authors have used inaccurate data, prompting NOAA Administrator Kathryn Sullivan to declare, "I have not or will not allow anyone to manipulate the science or coerce the scientists who work for me."[5] Whether or not political manipulation of science is at the root of this quarrel, it is difficult to ignore the ideological undertones. This clash between the scientific and political worlds occurs too often and is just one problem in S&T policymaking that should be addressed.

HOW ARE S&T POLICIES CREATED?

Some technical policies evolve from the passage of a body of related laws, others are carefully crafted by experts in the field, and still others spring ad-hoc from various activities. Normally, formal policies reflect an overarching goal developed by either the Executive or Legislative branch, as promulgated by the relevant agency (e.g., civil service department) and often informed by academia or the private sector. The Judicial Branch is sometimes involved in S&T decision-making, usually when arbitration of legal aspects of strategy and policy is required.[6]

It is instructive to consider some of the players and issues that are part of the process of setting technical policy at the national level.

The Executive Branch. The Director of the Office of Science and Technology Policy (OSTP), sometimes granted the additional title of "Presidential Science Advisor," is the principle S&T advisor to the President. Established in 1976 by Public Law 94-282, the Director's function is to "provide the Executive Office of the President with advice on the scientific, engineering, and technological aspects of issues that require attention at the highest levels of government,"[7] thereby codifying into law prior functions of the Office of Scientific Research and Development (during WWII) and the President's Science Advisory Committee. The OSTP, as established in the 1976 law, "serves as a source of scientific and technological analysis and judgment for the President with respect to major policies, plans, and programs of the Federal Government." OSTP's strategic goals and objectives include promoting science for "economic prosperity, public health, environmental quality, and national security." The office provides insight and guidance on subjects such as optimizing the science and technology workforce and the government's participation in the national S&T enterprise.

The Director of OSTP is also the co-chair of PCAST, the President's Council of Advisors on Science and Technology. The PCAST advises on "technology, scientific research priorities, and mathematics and science education "utilizing resources within the private sector and academia." There is also a National Science and Technology Council (NSTC), chaired by the Vice President and served by the Director of OSTP, Cabinet Secretaries, S&T-related Agency Heads, and others.

The NSTC's mission is "to prepare coordinated R&D strategies and budget recommendations to orient science and technology toward achieving national goals, which involves coordinating the parts of the Federal R&D enterprise." NSTC coordinates actions in selected areas of S&T by directing Interagency Working Groups (IWGs) to study particular issues. Some of the recent reports by the NSTC are on the National Nanotechnology Initiative (5th Assessment), Education Technology, Antibiotic Resistance, and Big Data and Privacy.

In 1991, Congress created a Critical Technologies Institute, renamed the Science and Technology Policy Institute (STPI) in 1998. The Institute is a National Science Foundation-sponsored federally funded research and development center (FFRDC). STPI's stated mission is "to help improve public policy by conducting objective, independent research and analysis on policy issues that involve science and technology." The main activity of STPI is to support OSTP, although it also supports other agencies in the Executive Branch. Despite lofty and worthwhile aspirations, OSTP and its organizations are poorly resourced and insufficiently empowered to proactively analyze and make recommendations concerning the S&T areas that need better policies.

The Legislative Branch. The Congressional Research Service (CRS) is "the public policy research arm of the United States Congress. As a legislative branch agency within the Library of Congress, CRS works exclusively and directly for Members of Congress, their Committees and staff on a confidential, nonpartisan basis."[8] The Service's output includes reports on major policy issues (approximately 700 per year), memoranda, briefings, consultations, seminars and workshops, expert testimony, and individual inquiries.

Under different names, CRS has advised Congress since 1914. Their staff of around 600 is organized into six divisions, one of which is Science and Industry. Their responsibilities for scientific topics grew when Congress eliminated the Office of Technology Assessment (OTA) in 1994.

On specific issues, the Congressional Budget Office (CBO) and the Government Accounting Office (GAO) may also provide perspectives that affect or are affected by S&T. The GAO includes an office of Technology Assessment and a chief scientist. Common to the CRS, CBO, and GAO is that their participation is by invitation only. A member of Congress must initiate an examination by one of these organizations, so their part in the process is seldom proactive and independent. Further, the service makes no recommendations to Congress and public access to (and comment on) their work is generally denied.

POLICY FOR S&T INVESTMENT

The NSTC is instrumental in establishing a national R&D budget. The committee and OMB develop research priorities and issues directives to agencies. Each department submits its budget to the OMB for separate consideration. OMB does not look at R&D consistency with national objectives before sending it on to Congress. A simplified version of the R&D budget trek from agency-to-President-to-OMB-to-Congress is shown in Figure 1.

The House Science Authorization Committee considers a large portion of the consolidated R&D budget (exempting DOD), but then it is split up into the appropriations subcommittees. There is no formal coordination among the subcommittees regarding how separate R&D programs may affect one another. The separation of the appropriations subcommittees is analogous to the way the appropriations bills are considered. Legislators do not have the opportunity to analyze the collective R&D budget before voting separately on each section.

S&T FOR POLICY

The second type of S&T policy deals with the technical content of policies that govern or guide the management of national issues or initiatives. In this case, the purpose of the technical aspect of the policy is to ensure that the scientific foundation of the policy is correct. Although S&T investment may be part of the policy, it is not its focus.

These policies occur at every level of government and society. They become impossible to fashion and defend when bad science is used, either intentionally or inadvertently, as their basis. Just one example is our

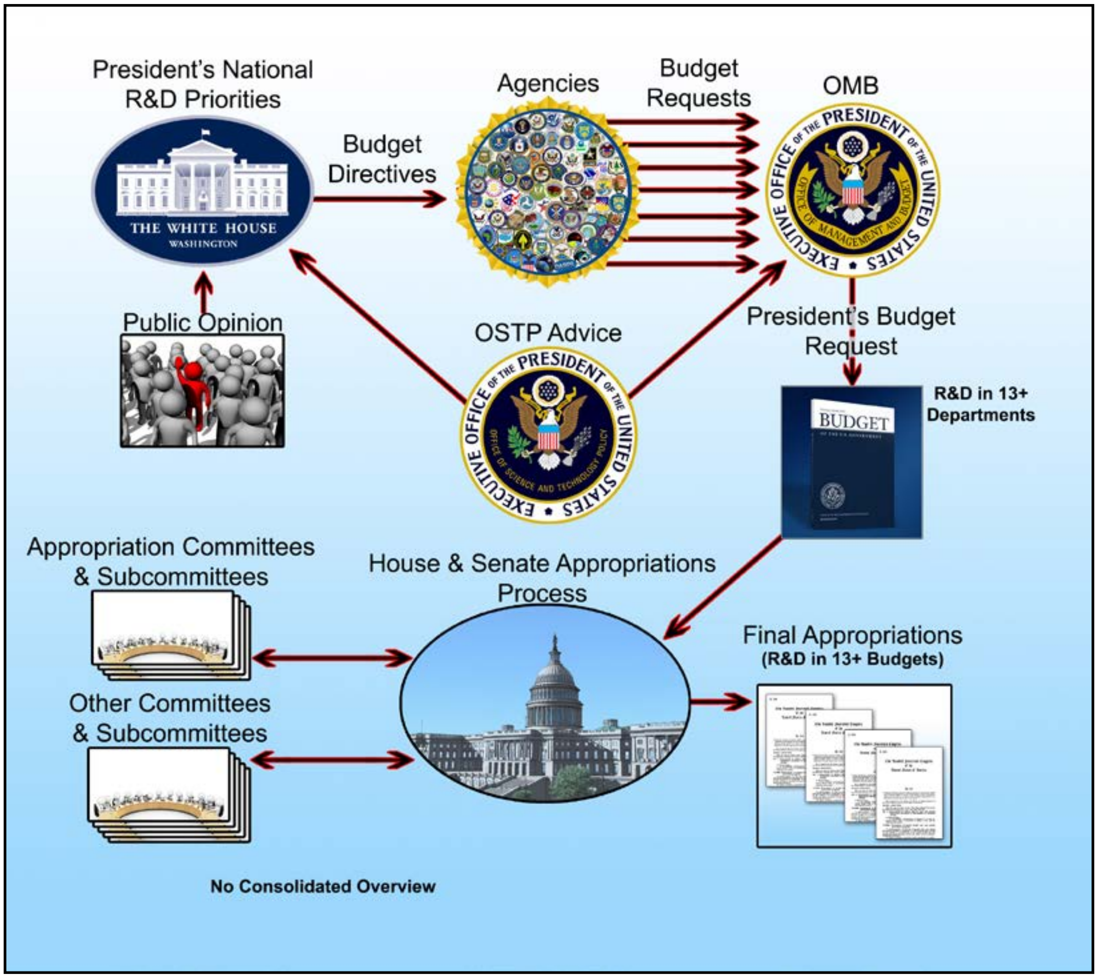

Figure 1. Agencies' R&D Budget Preparation (Image Credit: Alex Taliesen).

MOTIVATION	Subject Matter Expertise	Mechanism	S&T Performers
National security	Government agencies and officials	Budget	Government Agencies
Health and other public good	Associations	Organization	Contractors
Political constituents	Not for Profits	Legislative	Academia
General public	Advisory panels and committees	Budgetary	Private Sector
		Tax Structure	
		Law	
		Position	
		Political (Ad Hoc)	

Table 1. Influences to policies with S&T content.

difficulty in dealing with tradeoffs between immediate gratifications and future benefits, such as promoting savings over spending or husbanding our resources and ecological health for the benefit of later generations.

Many issues confronting the nation require considerable S&T expertise. A few considerations and players in this process are summarized in Table 1. Motivation to address an issue involving S&T content can arise from nearly any quarter, but it often comes from one or more of the sources listed in the first column. Subject matter experts may include government or non-government personnel and organizations, thus the need for advisory panels. The mechanism to resolve issues most often comes from the political or the budgetary community. Finally, if the issue is one of constricting or expanding the vision of a particular area of research, the effect of decisions is often visited earliest on S&T performers, often with sudden changes in direction.

ISSUES WITH TODAY'S S&T POLICYMAKING PROCESSES

This discussion of how S&T policy is created makes two main points. First, there are few explicit criteria to guide the process, which therefore tends to be driven by extraneous agendas. Second, there are too many players and organizations often episodically involved in policy-making to do it well.

The missions of the OSTP, NSTP, the PCAST, STPI, and, of course, the National Academies of Science, suggest that each of these organizations have major, and even overlapping, roles in guiding S&T policy. But, while these organizations advise the President and his staff on S&T, they don't develop detailed S&T policies that holistically support national strategies. They generally become involved in issues-of-the-day, rather than proactively addressing even larger issues that will surface tomorrow. The result is a continual game of "catch-up."

Moreover, OSTP and CRS are viewed as being subordinate to their masters, namely the Administration and Congress, respectively. There are also inevitable policy discontinuities arising from changes of Administration and Congressional make-up. Accordingly, their objectivity and ability to prioritize is often challenged.[9] Agency-level organizations, on the other hand, tend to have more credibility with both the Administration and Congress because they are reliant on both.

Too often, forces try to "bend" science and scientific advice toward their self-interest, which in many instances causes distortions. The introduction of bias is often attributed to political players, but scientists too can be tempted by self-interest – for instance, by promises of funding for their discipline.

And of course, there are honest disagreements that require adjudication. Many theories or truths in science attract controversy, even within the scientific community. Similarly, a new technology may have consequences that are socially and economically positive overall, but include facets that create opposition.

Policymaking should incorporate methods that objectively focus the process on the real character of the individual issues and goals to be pursued in their resolution. For example, many technical problems are amenable to projecting outcomes and considering benefit versus cost. Forms of risk analysis may be harnessed to determine the likelihood of harm from actions taken, or not taken. The precautionary principle provides a means to approach these kinds of unknowns with care.[10] Famously, the original cost/benefit analyses performed on nuclear power plants were extremely favorable; risk analyses were not, and those risks raised costs enormously and crippled a large nuclear component to our national power solution.

Fortunately, there is plenty of good scientific advice to aid in addressing these problems, such as the National Academies of Science (NAS). Interestingly, the NAS was founded by Abraham Lincoln. Eventually, the NAS gave rise to the NSTC. At government's call, scientists are generally willing to apply their expertise to any problem or decision. Further, a rich "information circuit" of papers and data, including most reports from advisory committees and individuals, is open and widely available through the Library of Congress.[11] The difficulty is in taking advantage of this advice and transforming it into a consistent and wise policy.

The desire to include all stakeholders and opposing views on advisory groups often presents a complication. Increasingly, Government is called upon to respond to interests whose voices are omitted from the advisory process.[12] Sometimes that opposition comes from the scientific community, for even the most fundamental "scientific truths" can be overturned by refutive observations. The noteworthy example is global climate change, where a few voices dissent from the scientific consensus of anthropomorphic climate influences.[13] Clearly, there are many options and ways of shaping and using panels to deliver cogent advice.[14] But even if successful, the advice need not be respected. For instance, recipients might not absorb the information, or it might be picked over to support separate agendas.

A special challenge in S&T policy is how to address its non-technical components (e.g., economic, ethical, or social) without drowning out the scientific details. While the constitution of an advisory body might understandably include private citizens and special interest groups to pursue a diversity of viewpoints, care must be taken to fully understand and articulate the scientific facts behind the recommended policies as well as to consider other factors.

FUTURE DIRECTIONS FOR NATIONAL S&T POLICYMAKING

How do we solve these apparent shortcomings, considering the complex technical issues involved and the nature of the layered policymaking bureaucracy that is often at war with itself? One radical approach is to introduce a new organization whose charter and manning are tailored to address them.

We will arbitrarily call this organization the Office of Science Policy (OSP). It could be an agency or a department and we propose that it should operate at the cabinet–level. The OSP must have well defined and jurisdiction-limited missions, for example to avoid duplicitous power over agency mission R&D funding. The principal mission of the Office is to recommend policy and issues that should be considered and to advise the government on the best way to maintain or update existing policies.

What would the OSP look like, where would it live, and would it be worth the expense and effort? In view of the challenges discussed above, there are several things the OSP must do well.

First, it must be able to project and proactively consider long-term S&T policy needs and coordinate the development of appropriate policies to respond to those needs. This demands an ability to organize and aggregate mountains of data, facts, and trends, and to focus thought on optional paths that guiding policies could take. The final product would be recommendations on technical policies at the national level. While other aspects of policy must be considered, the OSP's emphasis must be on S&T. Simply maintaining sufficient continuity to identify and lead national thinking on technical issues would be an important contribution.

Encouraging advice from appropriate sources, sifting through that advice interactively with the advisors, and ensuring the best ideas are aggregated and incorporated into policy is an immeasurably important task. This responsibility includes harnessing the government's in-house technical expertise, which is seldom done well, despite the good intentions of the NSTC.

Another vital mission is raising or augmenting the level of technical understanding of policymakers and the populace. This is challenged by the rate of S&T progress. Given the exponential growth in technology and capabilities, it has become a progressively more profound task to develop comprehensive technical policies. Supporting educational initiatives, such as STEM, and improving approaches to explain complex issues and policies should receive OSP's support.

The NSTC could serve as a template for the OSP. Eventually, melding the NSTC into the OSP may be desirable. However, as a civil service organization the OSP must be able to avoid the "see-saw effect" on issues disrupted by change in administrations and change in party majorities. This requires a focus on the issues at hand, rather than distractions by political issues de jour. The OSP would need to be subject to oversight by both Congress and the White House.

There are, of course, impediments to establishing a large new office or department – just consider the birth of the Department of Homeland Security. Nevertheless, as reported in the PREST conference proceedings, there have been many attempts to establish an office or Department of Science. The 1880s brought about the initial attempt at a Department of Science, when the Allison Commission proposed conjoining all scientific offices and bureaus into one national department. The laissez faire spirit of the time, however, was illustrated with Congressman Hilary Herbert saying, "Government patronage shackles that spirit of independent thought which is the life of science."[15] More recently, the period after the Vannevar Bush's report to FDR resulted in various national scientific offices (NSF, NASA, ONR, AEC, etc.). In all, there have been 60 or so attempts to combine the Federal S&T agencies reflected in bills in Congress. The President's Commission on Industrial Competitiveness of the Reagan Administration proposed consolidation of Federal S&T initiatives under a new Department of Science and Technology. Subsequently, there persisted the introduction of Bills to establish some sort of overarching department well into the mid-1990s.

So, while a Department of Science could have had benefits in the nation's R&D budgeting, policymaking, and cross-fertilization processes, it was not to be because of concerns about its affects on the missions of other federal departments. We believe these problems would be mitigated under an Office of Science Policy, which may even tend to promote agency-level science.

THREE ILLUSTRATIVE EXAMPLES

Let us consider three mega-science projects where the federal government made poor decisions. Each has non-scientific factors, such as economic or ethical aspects, but the technical and scientific forecasting were crucial to their success or failure. In the following, we extend the analysis of these case histories presented during the PREST conference by imagining how the recommended policy actions might have helped to make things better.

1. Human Genome Project.

The Human Genome Project is viewed as a supremely successful big-science national program. The program met its goals, below budget and earlier than scheduled, a tribute to good policy and management. Even so, the project was originally designed to disseminate into the public domain genetic information and deeper knowledge. But, an enthusiastic and capable private sector joined in, accelerating progress while demanding a broad swath of patents in the field (thus restricting dissemination and use of basic information). There is a need to balance the incentives to inventors and researchers against the benefits of broadly sharing results of experimentation and analysis that might lead to new breakthroughs or better products.

Would the recommendations made in this article have made the program more effective? While the federal government did an excellent job of ensuring the broad participation of stakeholders and researchers, perhaps

Jonathan Bailey, NHGRI.

PD: US Government.

the proactive thoughts and analysis of a policy-oriented office could have better addressed the patent issue, and could have attempted to streamline transition to applications. For example, more expert input could have anticipated the innovative way in which the private sector applied computer science matching algorithms to the problem of sequencing the genome. This expertise would have been available in several government agencies, but not necessarily in the National Institutes of Health (NIH), so this may have been an excellent opportunity to initiate an interagency task force that included better computer knowledge.

2. Superconductivity Supercollider.

Originally planned and approved for $4.4 billion by the government, and competed throughout the US, the Superconductivity Supercollider (SSC) was designed to find the Higgs particle. The project, which would have allowed the US to maintain world leadership in high-energy physics, began construction in Texas in the late 1980s, following a feasibility study and several stages of development. The SSC was to include two 53-mile-long stacked rings and construction was to have taken eight years, but in 1995 Congress terminated the still unfinished project. This left the science exploration to the European Large Hadron Collider. The program completed over 10 miles of track, expending about $2 billion, before ceasing activity with little return on investment. Magnablend, a chemical company, now owns the site.

According to *Scientific American*, "at its end the project was already employing 2,000 people at the site or in Dallas, about 200 of whom were scientists, plus a contingent of Russian physicists employed after the end of the Cold War. Another 13,000 jobs linked to the project never materialized. About half the SSC scientists left the field of physics, according to a 1994 survey by *Science* magazine, some to become analysts in the financial industry. Many took a loss on homes sold in a sudden buyer's market."[16]

The extent to which national attention would have made a difference in this tragic waste of scientific funds depends upon how much of the blame should be placed on the policymaking stage versus poor execution. For instance, cost overruns brought the project to an estimated $11B in 1994 dollars. But the policy strategy should have included better program management by an appropriate agency, which might have solved many execution problems. The management strategy should also have more persuasively articulated the program goals to a largely disinterested public, not to mention to physicists who opposed the spending levels that precluded numerous small projects. Most notable, however, is the need for a cogent process to choose, structure and manage large programs that include both science and infrastructure.

3. International Space Station (ISS).

Another mega-science project (estimated at $160B thus far and costing an additional $3B per year) is NASA's International Space Station (ISS) program. The program was to minimize expenditures of a previous plan, "Space Station Freedom." Interestingly, the project competed against the SSC for funding. Initially, the ISS was advanced as an orbiting scientific research, with the promise of a useful platform for scientific investigation and discovery. Scientific advisors, including the National Research Council, warned that ISS's enormous cost burden could not be rationalized by the scientific value of the proposed research. In spite of this, defense for the project continued. One specific promise of the program was to enable the scientific study of humans in space. Once clear that the true goal was not scientific, focus shifted to international aspects of its value, emphasizing commercial, diplomatic, and educational goals. Since inception, Russia was a crucial partner. However, Russia's involvement declined as its economic and infrastructure problems increased. Other countries also participated, but the burden of the program increased, resulting in significant overruns for the US.

NASA/Crew of STS-132.

NASA made several attempts at commercialization and privatization of the payload and station. Industry was disinterested in the intermittent accessibility and expense of this "factory in the sky." The mutual dependence of the ISS on the Space Shuttle was difficult due to the Shuttle's carrying inefficiency. Then, after two Shuttles and crews were lost, the shifting importance of the key to success in orbital space became getting there and back, safely and affordably – not orbiting. These arguments were forwarded during that time, but had not been sufficiently considered at the national level.

If an OSP had been engaged in the process of pursuing the ISS, perhaps more attention would have been paid to the tradeoffs between science and the program plan. At any rate, the logic behind improving earth-to-orbit transport could have been escalated to the national decision levels. Again, political, rather than scientific rationale continues to drive its continuation, now extended to 2024.

CONCLUSION

Our country is the most prolific discoverer of scientific fact and provider of useful technology in history. We have investigated our universe from the outer reaches of space to the smallest of particles. And we have invented more effective ways to harness that knowledge and put it into use, from feeding exploding populations to digitally communicating with the world. But, mankind's challenges are just beginning. Resource shortages, climate change, the population explosion, and many other critical, complex, and massively interactive trends call upon our resolve to do a better job in setting and pursuing worthy goals. S&T policy must be at the center of these tasks and we must turn our national talents toward making them work.

NOTES

1. Sponsors included: Senator Jeff Bingaman, Senator Joseph Lieberman, Representative Curt Weldon, Deputy Undersecretary for Defense (Science and Technology), Air Force Office of Scientific Research, Department of the Army, Defense Advanced Research Projects Agency, National Intelligence Council, National Science Foundation, Office of Naval Research, US Coast Guard, and the Potomac Institute for Policy Studies.
2. "Shaping Science and Technology to Serve National Security (PIPS-05-02)", James Richardson, Whitney Matson, and Robert Peters, Potomac Institute for Policy Studies, 31 Jan. 2005.
3. "Innovating Science Policy: Restructuring S&T Policy for the Twenty-first Century," James Richardson, Robert Peters, and Whitney Matson, *Review of Policy Research* November 2004; 21(6): 809–828.
4. James J. Richardson, Whitney Matson, and Robert Peters, "Promoting Science and Technology to Serve National Security" In: *Science and Technology Policies for the Anti-terrorism Era*. Edited by Andrew D. James (Washington, DC: IOS Press; 2006).
5. The results of the study were published in *Science*. According to the article, "Standoff over government climate study provokes uproar by scientists," by Lisa Rein, *Washington Post*, 24 November. According to this article, the review process took 50 percent longer than the normal 109 days that is normal for the journal.
6. In the area of intellectual property rights, the Judicial Branch may have a considerable influence on S&T. For instance, patents being granted or renewed for modified pharmaceuticals and for organisms derived from genetic manipulation are being challenged on a legal basis. This represents a trade-off between placing important data in a public status where everyone can use it, or keeping it in a private domain to provide commercial motivation.
7. All quotes in this section are taken from the White House website, see: https://www.whitehouse.gov/administration/eop/ostp/about.
8. All quotes in this section are taken from the CRS Website, see: https://www.loc.gov/crsinfo.
9. See, for example, Eamon M. Kelly, "Federal Research Resources: A Process for Setting Priorities, National Science Board, October 11, 2001; Steven W. Popper, et al, "Setting Priorities and Coordinating Federal R&D Across Fields of Science: A Literature Review," Rand, April 2000; and Daniel Sarewitz, "Social Change and Science Policy," *Issues in Science and Technology Online*, June 5, 2003.
10. John D. Graham, Administrator of the Office of information and Regulatory Affairs at the Office of Management and Budget has written of various issues treated through the precautionary principle. See, "The Perils of the Precautionary Principle: Lessons from the American and European Experience," Regulatory Forum of the Heritage Foundation, October 20, 2003.
11. The NAS alone publishes over 200 books and many more reports per year.
12. Frederick Anderson makes several interesting suggestions on how government can improve the process of forming advisory panels in, "Improving Science Advice to Government," Issues, September 15, 2003.
13. If the majority/minority positions on climate change were switched, we would not even be discussing it.
14. I am not encouraging government officials to micromanage advisors. In fact, such activity would undermine one of the strengths of our nation's R&D system. Rather, the aim is to make that advice more specific and useful.
15. H.A. Herbert, Restricting the Work and Publications of the Geological Survey..., May 5, 1886, 49 Cong., I Sess, H.R. Report 2214 (Ser. 2441), 16.
16. "The Supercollider that Never Was, David Appell, *Scientific American*, Oct. 15, 2013.

Photo credit.
Architect of the
Capitol (aoc.gov), PD.