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PIELKE'S PERSPECTIVE

Roger Pielke, Jr.

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Science Academies as Political Advocates

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What role should national science academies play in policy and politics?

One answer to this question was provided last month when eleven national science academies sent a letter to "world leaders, including those meeting at the Gleneagles G8 Summit in July 2005" advocating a number of specific policy actions on climate change. The letter - from science academies in Brazil, Canada, China, France, Germany, India, Italy, Japan, Russia, the United Kingdom, and the United States - indicates that these national science academies perceive one of their roles to be overt political advocacy.

As the public has demanded a closer connection of science with society, the action of the science academies is part of a broader trend for scientists and scientific institutions to become more involved in the political fray on a wide range of issues involving science. While each individual scientist has a very personal decision to make about whether or not to engage in political advocacy, there are real risks for the scientific enterprise when science academies become political advocates.

There are at least three reasons why political advocacy by science academies should be greeted with caution:

One reason is simply practical - science academies have much to lose (including stature, legitimacy, public funding, etc.) if they take on the characteristics of an advocacy-oriented interest group. Regardless of the merits of the actions on climate change called for by the 11 academies, by endorsing a particular political agenda, the academies may compromise their future ability to serve as resources for policy makers on scientific issues. After all, one reason that policy makers look to science academies to provide reports on science rather than to, say, pharmaceutical companies or environmental groups, is because policy makers believe that science academies will not shape science to fit a pre-existing political agenda. By endorsing a political agenda, science academies begin to resemble these other groups.

The second reason has to do with the needs of policy making - sometimes all of the available options on a particular issue are bad ones. Climate change is a great example, as the options currently being debated and implemented, both on mitigation and adaptation, are not proving particularly effective. Yet, in their letter, the science academies are, in effect, calling for renewed support of the current approach to emissions-reduction under the Climate Convention that has proven woefully inadequate over more than a decade. Sometimes effective policy making requires more than just picking sides in a two-sided debate - specifically, the introduction of new and innovative possibilities for action. One of the most important, but overlooked, lessons of national and international responses on ozone depletion and acid rain is that new options can break a stalemate (e.g., think of substitutes for chlorofluorocarbons in the case of ozone depletion, or tradable permits in the case of acid rain). When science academies engage in political advocacy by taking a side in an existing debate, they miss their opportunity to suggest options previously unseen or underappreciated that might break a gridlock or prove more practically effective.

The third reason has to do with democratic accountability. For example, in the United States, the National Academy of Sciences is supported in large part with public funds. But when taking advocacy positions, who are they accountable to? Also, where does advocacy stop? Should science academies endorse specific candidates running for election or issue position papers on pending legislation? This is, of course, what special interest advocacy groups do, and do very well. Democracy is strengthened by political advocacy. But national science academies, especially those supported by public funds, are supposed to work in support of common interests, not particular special interests. If national academies continue down the path of issue advocacy, they should not be surprised if they are soon viewed by the public and their representatives as just another special interest group. The risk for science is not only the loss of particular political battles, but a potential diminution of the public support that has led to considerable, sustained investments in research over many decades.

Some might suggest that national academies should stick to science and not engage in issues of policy or politics. But as scholars of science, technology, and society have taught us, considering science as if it existed in a vacuum is only possible in highly idealized circumstances, usually those that are not politically controversial or scientifically complex. If we want science academies to be relevant to policy, science needs to consider social and political issues. So, if overt political advocacy is fraught with risk, and consideration of science alone is impossible, is there another option?

One way for science academies to closely engage with the needs of policy makers, but avoid recreating themselves as special interest groups, is to work to clarify and, if possible, expand the scope of choice available in decision making. For example, in the case of climate change, Oxford's Steve Rayner has commented:

It is plausible to argue that implementing Kyoto has distracted attention and effort from real opportunities to reduce greenhouse gas emissions and protect society against climate impacts. While it may not be politically practical or desirable to abandon the Kyoto path altogether, it certainly seems prudent to open up other approaches to achieving global reductions in greenhouse gas emissions.

The work of groups such as the National Environmental Assessment Agency of the Netherlands National Institute of Public Health and the Environment that are exploring innovative approaches to climate policy is typically overlooked in the general enthusiasm to join the existing two-sided climate debate. Climate policy desperately needs new options, and science academies are among the very few places with the authority and legitimacy necessary to introduce new options to the public debate.

Science academies face choices in how they interact with the broader societies of which they are a part. Such choices ought to be made with a clear understanding of the consequences for both science and society. There are undesirable consequences of science academies either seeking to focus only on science or taking on the role of political advocates. A better option may be for science academies to take on the role of honest brokers of policy options, for if they do not take on this role, who will?

Sources

- Academies Joint Statement: http://nationalacademies.org/onpi/06072005.pdf
- Rayner, Steve: http://www.publications.parliament.uk/pa/cm200405/cmselect/cmenvaud/105/4121506.htm
- Netherlands National Institute of Public Health and the Environment: http://www.rivm.nl/bibliotheek/rapporten/500036001.html

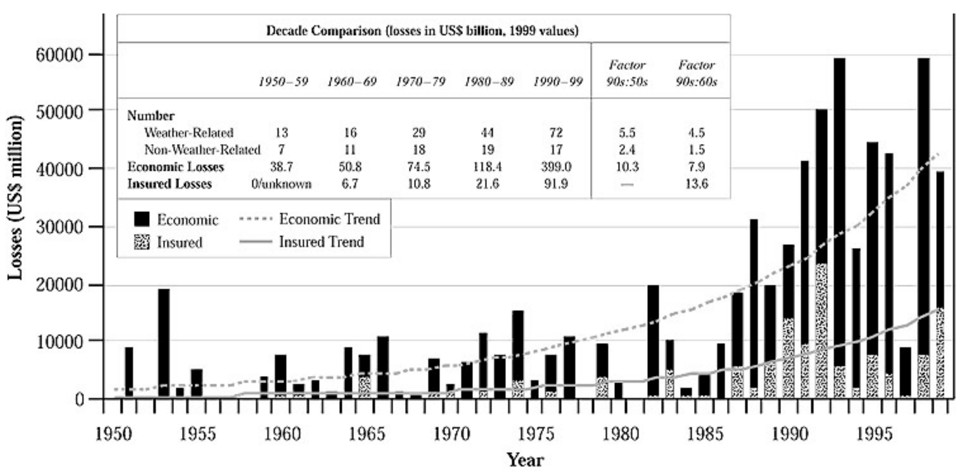
Making Sense of Trends in Disaster Losses

Volume 7 | September 20, 2005

Record rainfall and over a thousand dead in Mumbai. Devastating floods in central Europe. A record hurricane season in the Atlantic, including more than $100 billion dollars in damage from Hurricane Katrina. The summer of 2005 seems to have witnessed more than its fair share of weather-related disasters. And, perhaps understandably, no weather-related disaster occurs without someone linking it to the issue of global warming. For example, Klaus Töpfer, director of the United Nations Environment Programme, made such a connection in an interview with the Financial Times Deutschland. *"We live already in climate change. The worldwide increase in strong rains, droughts and (wind)storms are indications that the greenhouse effect is having an influence".*

But as logical and enticing as it may seem to connect the ever-growing toll of disasters with global warming, the current state of science simply does not support making such a connection. While politicians and political advocates might be expected to stretch the bounds of scientific accuracy, it is particularly troubling to see leading scientists join them. For instance, the former head of the UN's Intergovernmental Panel on Climate Change (IPCC), Sir John Houghton, testified before the US Senate last July that increasing disaster losses could be attributed to increased storminess. And Rajendra Pachuri, the current head of the IPCC, suggested last February that the escalating costs of disasters could be attributed in part to climate change. Yet such claims are simply not supported by scientific research.

It is true that weather-related disaster losses have increased dramatically in recent decades. A figure (http://www.grida.no/climate/ipcc_tar/wg2/fig8-1.htm) published in 2001 by the IPCC shows how dramatically disaster costs have escalated.



If we hypothesize that changes in weather patterns are responsible for some part of the trend of increasing disaster losses, then it is logical that the first place we might look is for changes in the behavior of weather extremes. The most recent IPCC took a close look at research on extreme weather events and found little evidence for changes over time:

Over recent decades, the IPCC found no long-term global trends in tropical or extra-tropical cyclones (i.e. hurricanes or winter storms), in "droughts or wet spells," or in "tornados, hail, and other severe weather." In the absence of trends in these weather events, they cannot be responsible for any part of the growing economic toll. More recently Kerry Emanuel published a study in Nature that described a increase in the intensity of hurricanes in the North Atlantic and North Pacific, but this trend is not related to increasing damage. Emanuel writes on his website, "There is a huge upward trend in hurricane damage in the U.S., but all or almost all of this is due to increasing coastal population and building in hurricane-prone areas. When this increase in population and wealth is accounted for, there is no discernible trend left in the hurricane damage data."

The IPCC did find "a widespread increase in heavy and extreme precipitation events in regions where total precipitation has increased, e.g. the mid- and high latitudes of the Northern Hemisphere." But at the same time the IPCC warned that "an increase (or decrease) in heavy precipitation events may not necessarily translate into annual peak (or low) river levels." Indeed, while the IPCC found some changes in streamflow, it did not identify changes in streamflow extremes (i.e. floods), and concluded on a regional basis that: "Even if a trend is identified, it may be difficult to attribute it to global warming because of other changes that are continuing in a catchment." A recent study by the International Ad Hoc Detection and Attribution Group, published in the May 2005 *Journal of Climate*, was unable to detect an anthropogenic signal in global precipitation.

These findings are consistent with research seeking to document a climate signal in a long-term record of flood damage, which has concluded that an increase in precipitation does indeed contribute to increasing flood damage, but the precise amount of this increase is small and difficult to identify in the context of the much larger effects of policy and the ever-growing societal vulnerability to flood damage.

While it is understandable why some advocacy groups might stretch the bounds of present scientific understandings to link recent disasters and climate change to advance a political agenda, why is it that many scientists, who should know better, make the same claims?

One important reason for some confusion among scientists stems from a claim made by the 2001 IPCC (by Working Group II) attributing some part of the trend of increasing disaster losses to changes in climate. Upon a closer look however the claim seems unfounded. The IPCC relies on a report published in 2000 by Munich Re that found that global disasters resulted in $636 billion in losses in the 1990s compared with $315 billion in the 1970s, after adjusting for changes in population and wealth. The Munich Re report concludes that disaster costs have increased by a factor of two (i.e. 636/315), independent of societal changes, and the IPCC suggests that climate change is responsible for the difference.

Methodologically, the calculation is suspect for a number of reasons. First, Munich Re provides neither their methods nor data. Second, Munich Re admits that data on changes in wealth are not available around the world and changes in GDP are not always a good proxy for data on wealth. Third, Munich Re's data apparently includes weather and non-weather events (e.g. it appears to also include earthquake damages).

But let's assume that all of the issues raised above can be overcome, and in the end there remains a 2-to-1 ratio. The fact is that the large decadal variability in disaster losses makes it quite dodgy to assert a trend by comparing two different ten-year periods over a period of 30 years. Let me illustrate this with an example from our database of hurricane losses. If we adjust the hurricane loss data, accounting for trends in population, wealth, and inflation, to 2004 values and then compare decades, we see some interesting things. First, the ratio of the 1990s: 1970s is quite similar to the Munich Re analysis, 2.1 ($91B/$43B). But if we look at other decadal comparisons, the picture looks quite different, 1990s:1940s = 1.0 ($91B/$90B) and 1990s:1920s = 0.6 ($91B/$154B). The bottom line is that the 2000 Munich Re analysis tells us nothing about attribution of the causes for increasing disasters, yet its results were used by the IPCC to suggest otherwise.

Our group at the University of Colorado has partnered with Munich Re to hold a workshop in 2006 which will discuss and debate the attribution of recent trends in disaster losses, and work towards a rigorous, scientific consensus on this subject. I am quite impressed by Munich Re's commitment to rigorous research. With further research we may yet identify a climate change signal in disaster losses.

As Hans von Storch and Nico Stehr wrote earlier this year in Der Spiegel, when scientists invoke unsubstantiated claims to support a political agenda, it creates fodder for obstructionists to action on climate, and misleads the public and policy makers. There are good reasons for more substantial action on energy policies, particularly in the United States; and there are good reasons for concern about the growing toll of disaster losses around the world. But suggestions that the escalating disaster losses should motivate action on energy policy are not grounded in science, and cannot be an effective approach to disaster management. If you think that the recent trend of increasing disasters is a result of climate change, take a closer look at the available science because the connection has yet to be proved.

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Links

- English summary: http://www.euractiv.com/Article?tcmuri=tcm:29-143409-16&type=News
- Sir John Houghton Congressional testimony: http://energy.senate.gov/public/index.cfm?FuseAction=Hearings.Testimony&Hearing
- Kerry Emanuel's statement on hurricanes and climate change: http://wind.mit.edu/~emanuel/anthro2.htm
- Detecting and Attributing External Influences on the Climate System: A Review of Recent Advances. The International Ad Hoc Detection and Attribution Group, pages 1291-1314, http://journals.ametsoc.org/doi/full/10.1175/JCLI3329.1.
- von Storch, H., and N. Stehr, 2005: Klima inszenierter Angst. Der Spiegel, 24 January. Available online at http://www.spiegel.de/spiegel/0,1518,338080,00.html; English translation available online at http://sciencepolicy.colorado.edu/prometheus/archives/climate_change.

The Role of Science Studies in Science Policy

Volume 8 | December 6, 2005

In recent decades, science has been increasingly called upon to forge closer connections with the broader society. The days of the basic researcher toiling away in a laboratory with little concern about or accountability to external influences seems to be growing more distant every day. The trend toward a more societally-responsive scientific enterprise has been well documented by scholars who study science in society. Concepts describing this trend - such as "Mode 2 science," "use-inspired basic research," and "well-ordered science" - will be quite familiar to anyone well-acquainted with the discipline of "science and technology studies." But this trend is not just something that affects natural scientists. It also affects scholars like myself who study science in society. This leads me to ask: What is the relationship between science studies and science policies? And how should that relationship be shaped?

One reason for the trend toward a more socially-responsive scientific enterprise is the significant contributions by which science can improve people's lives around the world. At a recent forum on science and technology academies in Africa, Lee Yee-Cheong, coordinator of the UN Millennium Project Task Force on Science, Technology, and Innovation, commented to his fellow scientists that, "Merely offering advice is not enough. I appeal to you: Get your hands dirty." Edward K. Kirumira, a member of the executive council of the Uganda National Academy of Sciences, expressed similar thoughts when he said at the same forum, "[Science and technology] is not only about finding the vaccine, for example; it's also finding solutions for community survival and mechanisms for care and support." There is a very real expectation that scientists today must do more than advance knowledge: They must participate in making that knowledge useful to society.

At the same time, there has been a recognition that science may be more supportive of society and better governed when stakeholders are involved in making science policy. Such involvement includes contribution to setting research priorities and also developing guidelines for research that threatens societal values, for instance research on genetically modified organisms or nanotechnology. Lord Winston, former Chairman of the UK House of Lords Select Committee on Science and Technology and current President of the British Association for the Advancement of Science, writes in the preface to a recent Demos pamphlet called "The Public Value of Science": "The scientific community is beginning to realise, but often reluctantly accept, that we scientists need to take greater notice of public concerns, and relate and react to them."

Helga Nowotny and her colleagues have observed that the ongoing transformation of science has been met with an understandably mixed reception. They write that those with the most to gain have accepted change positively. These include "politicians and civil servants struggling to create better mechanisms to link science with innovation, researchers in professional disciplines such as management struggling to wriggle out from under the condescension of more established, and more 'academic', disciplines and researchers in newer universities, other non-university higher education institutions or outside the academic, and scientific, systems strictly defined." On the other hand they assert that there has been more resistance from those whose interests were already being served quite well by science policies, including "researchers in those established disciplines and institutions who feared that the quality of science would be eroded if these levelling ideas gained political currency and that their own autonomy would be curtailed if more explicit links were established between research and innovation."

This dynamic can be seen in a February 2005 editorial in Science by Alan Leshner, Chief Executive Officer of the American Association for the Advancement of Science, who recognizes that science is in fact changing, but also believes that many scientists will not be happy about it. Writing earlier this year, Leshner observes, "historically science and technology have changed society, society now is likely to want to change science and technology, or at least to help shape their course. For many scientists, any such overlay of values on the conduct of science is anathema to our core principles and our historic success."

In this context it is quite easy for us scholars who study science in society to see ourselves as champions of Nowotny's practitioners and interdisciplinarians. But in recent years when I looked at what I actually did on a day-to-day basis, I saw myself writing grants, publishing papers, and generally acting exactly like those established researchers concerned about the quality of their science and autonomy - and thus preserving the status quo. If there was indeed a revolution going on towards a more socially-responsive science, it had yet to exert much influence on the field of science and technology studies.

Other scholars have come to similar conclusions. For example, Helga Nowotny and Michael Guggenheim observe that, unlike academic environmental studies programs that successfully educate environmental professionals, the science studies community "has succeeded merely in establishing its own academic base." This is problematic because the knowledge gained through such studies has much to offer practitioners of science policy.

To be sure, a number of science studies scholars have been exceedingly effective at transitioning their own work in accordance with the broader trend toward societally-responsive science - names like Jasanoff, Sarewitz, and Wynne come to mind. But for the field as a whole, many of the same challenges facing the broader scientific enterprise during this transitional period have yet to fully take root. Undoubtedly there will be increasing pressure, and increasing resistance, to science studies forging a much closer connection to the practice of science policy. The good news is that we should know exactly what's coming and how to deal with it. We just have to take a look at science studies of other disciplines and apply them to ourselves.

Links and References

- http://www.nationalacademies.org/nairobi/index.html
- http://www.sciencemag.org/cgi/content/summary/307/5711/815
- Nowotny, Helga, Peter Scott, and Michael Gibbons. "Re-Thinking Science: Mode 2 in Innovation Networks and Knowledge Clusters: A Comparative Systems Approach Across the United States, Europe, and Asia, edited by Elias G. Carayannis and David F. J. Campbell, Westport: Praeger Publisher, 2005.
- Nowotny, Helga and Michael Guggenheim. "Joy in Repetition Makes the Future Disappear. A Critical Assessment of the Present State of STS." In Social Studies of Science & Technology: Looking Back, Ahead. Sociology of the Sciences Yearbook, vol. 23, edited by Bernward Joerges and Helga Nowotny, Dordrecht: Kluwer, 2003.

Science Policy Without Science Policy Research

Volume 9 | April 19, 2006

In 1963 British philosopher Stephen Toulmin warned that decisions about science would be based on little more than "hunches and prejudices" unless scholars devoted more attention to scholarship on "science policy." More than four decades later, John Marburger, science advisor to President George W. Bush, expressed concern that science policy decisions were largely uninformed by science policy research and requested that "the nascent field of the social science of science policy needs to grow up, and quickly." It is in the interests of both the scientific community and the broader society which it supports to proceed with Toulmin's and Marburger's calls to intellectual arms and expect science policy research to play a greater role in science policy decisions.

Current discussion about science policy in the United States, focused on the issue of "competitiveness," provides some evidence for the importance of science policy research, but unfortunately through its absence in policy debate. The focus on "competitiveness" manifests itself in a number of proposed policies, such as the president's "American Competitiveness Initiative" and proposed legislation in Congress titled "Protecting America's Competitive Edge." These proposals share a focus on calling for the production of more scientists and engineers and a commensurate increase in science funding in the physical sciences, among other recommendations.

The current call for increases in science funding as a tool of economic competitiveness might be viewed in the context of a history of such arguments. Juan Lucena, a professor at the Colorado School of Mines, has documented how the scientific community has argued for more funding of science, and the consequent production of more scientists and engineers, as the policy solution for every major problem facing the United States since the launch of Sputnik in 1957. These problems have included the Cold War, environmental challenges, social strife and inequity, economic challenges posed by Japan, globalization, and the war on terrorism. Today's arguments follow in this tradition, with more science funding identified as the solution to economic threats posed by India and China.

The scientific community has been very effective in convincing policy makers that in funding more science lies the key to more jobs and a stronger economy. For instance, last month, Representative Frank Wolf (R-VA), Republican chairman of the House committee with responsibility for funding many science agencies, wrote an essay for the American Physical Society in which he expressed concern upon learning "from groups that advocate for business, education, and research and development . . . that three key measuring sticks show America on a downward slope: patents awarded to American scientists, papers published by American scientists, and Nobel prizes won by American scientists." Unfortunately his concerns are completely misplaced as US patents, papers, and prizes are not declining, but increasing.

Representative Wolf's misunderstanding of the state of science policy is unfortunately not a unique aberration. The widely cited but apparently little read 2005 report of the US National Research Council titled *Rising Above the Gathering Storm* (RAGS) is often invoked by scientists and policy makers as a basis for increased science funding and the production of more scientists and engineers; however, a close look at the report reveals a complicated picture of science in the economy, with no simple cause-effect relationships. For example, RAGS favorably cites a literature review by Alister Scott and colleagues at the University of Sussex produced for the UK Office of Science and Technology, which cites studies showing a return on investment from government spending on research and development of between 20 percent and 67 percent. What RAGS does not inform its readers about are the broader conclusions of Scott et al.:

> *The relationships between public research and innovation are recognised to be an increasingly significant topic in the emerging knowledge economy. However, this is an area beset by high levels of complexity and a surprisingly small amount of empirical research. It is a field where it is easy to be misled by simplistic ideas, or to become confused by such data as do exist and the conflicting interpretations that can be made from them. As this review will show, even now eminent commentators and analysts are grappling with some of the most fundamental dimensions of the relationships between research and innovation, science and technology.*

Instead of just more funding for science, or the production of more scientists and engineers as tools to improve a single nation's competitiveness, Scott and his colleagues argue that collaboration among networks of scientists in different countries is a key to economic growth - a very different message than the somewhat nationalistic tone taken by RAGS. Such critiques are not unique. For instance, in 1996 Charles L. Schultze, former chairman of President Jimmy Carter's Council of Economic Advisors, provided guidance for those seeking to explain the role of science in the economy: "First, do not specify the target as increasing competitiveness. *Competitiveness* is a virtually meaningless, if widely used, word. It can - and has been - used to justify virtually anything."

It seems that advocates for increased public support for science in the United States are crystal clear in identifying the solution - more science, more scientists - but completely incoherent in terms of delineating the problem that the solution is to address. There are far-reaching risks in such a situation.

First, science policy making might simply be ineffective from the standpoint of broad public goals. Will more funding for basic research in fact lead to the promised outcomes in terms of jobs and economic growth? To be fair, the various competitiveness initiatives currently being discussed contain provisions for improving pre-college education and teacher training, among other actions. But among much of the science community, the focus has been primarily on provisions which call for a dramatic increase in funding for the physical sciences. Yet, as the RAGS report readily admits, the connections of science funding with the promised corresponding outcomes are not based on rigorous understandings: "Even if unlimited time were available, definitive analysis of many issues is simply not possible given the uncertainties involved. The recommendations in this report rely heavily on the experience, consensus views, and judgments of the committee members." And it just so happens that the report's authors in industry and academia are also primary beneficiaries of the report's recommendations. None of this is to deny the possibility that the science policy recommendations currently being discussed might succeed with respect to their goals of jobs and growth. It seems, rather, that no one knows if they will succeed or not, which does not seem to be a good recipe for effective science policy decision making. Most scientists would likely object to a similar lack of a scientific basis for policy making in areas such as the environment, health, or national security - why should science policy making be any different?

A second risk is to the science community itself. In the United States, science and technology have had an extended unbroken record of tremendous public support expressed both in opinion polls and federal spending. In particular, over recent years government budgets for research and development have increased to record amounts at a pace not seen since the Apollo era of missions to the moon. Is it possible that such public support is risked if the scientific community acts like any other special interest group fighting for its share of public resources? History would suggest that such a risk is small, but given the increasing share of federal resources going to science and technology, and the promises made to the public to secure such increases, the scientific community should not take public support for granted. If for no other reason than to maintain a broad public view of the research enterprise, it is in the interests of the scientific community to ensure that the policies that it proposes can, in fact, work as promised. Science policy research is an important mechanism for understanding the relationship of science policies and their societal outcomes.

As we consider science policy decisions in the early years of the 21st century, scientists and policy makers would do well to heed the words of Stephen Toulmin from 1963:

> *Unless decisions about science policy are to be left to be made by éminences grises, we shall need a corresponding body of independent informed opinions about the natural history of science: men whose business is to undertake academic research on the intellectual foundation of scientific policy, and who are engaged continuously in a critical exchange of ideas with the actual policymaking agencies of government.*

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References

- President George Bush's American Competitiveness Initiative: http://www.whitehouse.gov/stateoftheunion/2006/aci/
- Congressional bill on Protecting America's Competitive Edge, Research and Education: http://www.cbo.gov/showdoc.cfm?index=7052&sequence=0
- Lucena, Juan. Defending the Nation: US Policymaking to Create Scientists and Engineers from Sputnik to the "War Against Terrorism." University Press of America, 2005.
- American Physical Society: http://www.aps.org
- US National Research Council. Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future, 2005. http://www.nap.edu/catalog/11463.html
- Schultze. C. L. 1996. Comment on Contributions of R&D to Economic Growth, by M. J. Boskin and L. J. Lau, pp. 107ff. in B. L. R. Smith and C. E. Barfield, Technology. R&D, and the Economy, The Brookings Institution and the American Enterprise Institute for Public Policy Research.
- Scott, Alister, et al. The Economic Returns to Basic Research and the Benefits of University-Industry Relationships: A literature review and update of findings. Report for the Office of Science and Technology, UK, 2001, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.25.2107&rep=rep1&type=pdf.

How to Break Up NASA

Volume 10 | June 29, 2006

The National Aeronautics and Space Administration (NASA) has a storied history, but today the agency is facing a wide range of problems. Consider the following concerns expressed recently about the agency by informed observers:

- *A recent National Research Council report concluded that "NASA is being asked to accomplish too much with too little," finding the agency to be unsustainable.*
- *The Space Shuttle program, still recovering from the loss of Columbia, is nearing its end. NASA Administrator Michael Griffin recently commented, "If we lost another vehicle I will tell you right now that I would be moving to shut the program down."*
- *On NASA's earth science programs, University of New Hampshire professor Berrian Moore, observed, "Today, when the need for information about the planet is more important than ever, this process of building understanding through increasingly powerful observations ... is at risk of collapse."*
- *On NASA's space science programs, Mark V. Sykes, director of the Planetary Science Institute in Tucson, Arizona, and Heidi B. Hammel of the Space Science Institute in Boulder, Colorado, and Ridgefield, Connecticut, recently wrote, "NASA leadership is laying the groundwork for an American space science program in permanent retreat. Research and analysis programs - the very foundation of future exploration efforts - are being cut by more than 25 percent through the 2006 and 2007 budgets to help pay for increasing costs in human spaceflight."*
- *A forthcoming National Research Council report on aeronautics research recommended that the "US government should conduct a high-level review of organizational options for ensuring US leadership in civil aeronautics."*

These perspectives are representative of concerns that NASA, which has struggled for decades to meet its own aspirations, is at a crossroads. And despite some notable successes, particularly in planetary exploration, it may now be time to rethink NASA as an institution.

At the core of NASA's problems are the challenges of transitioning to the post-Space Shuttle era. NASA's attempts to complete the space station program with the space shuttle while beginning to implement

President Bush's "Vision for Space Exploration" have created budget pressures that have resulted in large cuts to space and earth science programs, with perhaps more to come.

To understand the options for US civil space policy requires understanding how NASA has arrived at the situation in which it finds itself and, most importantly, understanding the lessons of experience and how to apply them to future space policies. It may be time to consider wholesale institutional reform if space policy is to return to its glory days of achievement and excitement. This essay describes how NASA might be broken apart in order to focus and prioritize its many missions.

Next Logical Steps to Nowhere?

NASA's current situation is grounded in decisions made almost 40 years ago in the aftermath of the Apollo program. The Apollo program was both a strategy of the Cold War and also a tribute to President John Kennedy's commitment to set foot on the moon during the decade of the 1960s. It was not part of a comprehensive approach to colonizing or commercializing space.

Congress actually began reducing funding for Apollo in the mid-1960s, and a post-Apollo approach to space policy was needed by the time that Neil Armstrong set foot on the moon. NASA officials sought to focus post-Apollo space policy on a single vision - Mars. NASA developed a set of options focused on this vision: go to Mars sooner, go to Mars soon, or go to Mars later. But by this time, national policymakers, including President Nixon, had turned their attention from the moon (been there, done that) to the Vietnam War, and additional achievements in space were not high priorities. So the Mars vision was rejected.

NASA then sought to keep its vision alive by developing a more politically palatable approach. Thus it came up with what came to be characterized as the "next logical steps" leading in the end to Mars, but starting with a reusable space vehicle that could, in principle, be justified for reasons other than an ultimate Mars mission. Hence, NASA partnered with the military to develop what came to be known as the Space Shuttle and promised 48 flights per year at very low costs.

The logical step that would follow the Shuttle would be a space station in earth orbit, then followed by a mission to Mars. Today, NASA continues to pursue the vision first articulated 40 years ago.

Golden Handcuffs?

NASA's success in creating a political constituency in support of its "next logical steps" approach to the vision of landing a human on Mars has made change extremely difficult.

I first saw this constituency in action in 1991, when I served as an intern for the Science Committee of the US House of Representatives, then under the chairmanship of Congressman George Brown (D-CA). That year, the Appropriations Committee had voted to terminate the space station program, one of many congressional attempts to change NASA's approach to its vision. Chairman Brown, a fan of the space program, decided to take responsibility for leading the effort to overturn the cancellation and restore the program.

As an intern enlisted to play a small role in the Science Committee's campaign to reverse the Appropriations Committee's decision, I helped write speeches and prepare "Dear Colleague" letters to members of the House. I recall having available briefing binders, which must have been prepared by NASA or their contractors, that described in incredible detail the number of space station contracts that went to individual congressional districts as well as the number of jobs in each district.

The binders contained pages, prepared individually for each district, that could be copied and attached to a letter of support sent to each member's office. We made the case that canceling the space station was a jobs issue for individual districts. I'm not sure how big a role such information played in the ultimate vote to restore the station to the budget that year, but it seemed to me that it was a determining factor.

NASA's success in creating a structure of political support by spreading contracts around the nation in key congressional districts has made change difficult. Any alteration to the course that NASA is on will necessarily face opposition, if the changes result in termination of contracts and the loss of high-paying jobs in important congressional districts.

As a result, NASA's political successes have, to some degree, constrained its ability to implement needed policy change.

What to do?

NASA has far more on its plate than it can handle under any realistic budget projection. And even under unlimited budgets, it may be that NASA simply needs institutional reform. While the solutions aren't obvious, here are some radical ideas for reforming US space policy:

1. Consider major institutional change

The Cold War structure of NASA may have made sense following Sputnik, but it may be outdated in the 21st century. Congress should be open to the possibility of major change in the organization of space policy.

2. Separate human space flight into its own agency

The NASA vision of going to Mars has a committed constituency both inside and outside the agency. So long as the US public and their elected representatives support such a vision for space exploration, an institutional arrangement should be created where such a vision can be pursued on its merits and not conflated with science. NASA could be broken up, creating an agency focused narrowly on the vision of colonizing space - the Agency for Space Exploration and Settlement.

3. Move science programs to more appropriate agencies

Space and earth science programs could then be moved to agencies with missions more consistent with the goals of such research. For many years NASA's earth science program has faced challenges in transitioning its results and technologies to agencies with applied missions, such as the National Oceanic and Atmospheric Administration (NOAA) which focuses on weather, climate, water, and fisheries, among other areas. Many of NASA's mission-oriented earth science programs might be transferred to NOAA. This would not present a silver bullet solution to issues of technology transfer, but it would remove one important obstacle.

NASA's space science program, focused on exploration of space via robotic missions such as its highly successful Mars programs, might be transferred to the National Science Foundation (NSF), which is the home to a wide range of basic research. NSF has become increasingly interdisciplinary and such diversity may, in fact, result in benefits tospace science research and current science and engineering within NASA.

Similarly, NASA's aeronautics programs might be moved to the National Institute of Standards and Technology (NIST) which has an impressive track record of working with a wide range of industries.

NASA is organized in a modular, decentralized manner around laboratories and centers in many locations across the country, as well as in various universities and contractors. Such an organizational structure would make any reorganization fairly straightforward from an institutional perspective, although the political obstacles would likely be significant.

A proposal such as that suggested here may not make good sense or even be feasible. But it seems clear that US space policy will continue to face hard times unless policy makers begin to ask difficult questions that challenge the status quo. A proposal to break up NASA might be one way to open up such a discussion.

For Further Reading

- Despite Objections, NASA Decides to Launch the Space Shuttle on July First, Keith Cowling, 17 June 2006 http://www.spaceref.com/news/viewnews.html?id=1136
- National Research Council, 2006. An Assessment of Balance in NASA's Science Programs http://www.nap.edu/catalog/11644.html
- The Boston Globe, 9 June, 2006. NASA shelves climate satellites, Environmental science may suffer http://www.boston.com/news/nation/articles/2006/06/09/nasa_shelves_climate_satellites/
- Decadal Survey of Civil Aeronautics: Foundation for the Future (2006)
- Space News, 30 March 2006, NASA Space Science Continues To Be at Risk, Mark V. Sykes and Heidi B. Hammel http://www.spaceref.com/news/viewnews.html?id=110

Self-Segregation of Scientists by Political Predispositions

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Daniel Sarewitz has observed that the richness of science often provides an "excess of objectivity" in politicized debates. What he means is that for a wide range of contested policy issues there exists a diversity of scientific disciplines, methods, data, and analyses that lead to a wide range of research results. This intellectual diversity is then available to be selectively invoked by political advocates in support of their pre-existing agendas. Sarewitz describes the consequences as follows:

Rather than resolving political debate, science often becomes ammunition in partisan squabbling, mobilized selectively by contending sides to bolster their positions. Because science is highly valued as a source of reliable information, disputants look to science to help legitimate their interests. In such cases, the scientific experts on each side of the controversy effectively cancel each other out, and the more powerful political or economic interests prevail, just as they would have without the science.

The net result is that science often contributes very little to policy debate aside from ammunition for entrenched interests. The idea that scientists "cancel each other out" is problematic for those like me who think that science has much to offer policy makers in support of their decision making.

Scientists have not been innocent victims in these political dynamics. Writing in the National Journal, Paul Starobin suggests that: "Inevitably the scientist has been dragged, or has catapulted himself, into the values and political combat that surround science and has emerged, in certain respects, as just another (diminished) partisan."

Recent debate over hurricanes and climate change provides a perfect case study of these dynamics and the role that individual scientists play in creating conditions for the pathological politicization of science. The hurricane debate also offers some valuable experience suggesting how individual scientists might counter the "excess of objectivity."

In the spring of 2006, a group of scientists were collectively promoted in a press release by a group called TCS - Tech Central Station - which values "the power of free markets, open societies and individual human ingenuity to raise living standards and improve lives." Each of the scientists cited in the TCS press release believes that global warming plays little discernible role in hurricane activity. Clearly the scientists were selected by, or joined with, TCS because their scientific perspectives happened to be politically convenient.

Late in the summer of 2006, another group of scientists collaborated with an environmental group to promote research suggesting that sea surface temperatures had increased due to global warming. Each of these scientists believes that global warming is the primary reason behind increased hurricane activity. These scientists were similarly collected and presented as a group because their scientific perspectives also happened to be politically convenient.

On hurricanes and climate change, the reality is that there is a legitimate scientific debate going on, and Georgia Tech's Judy Curry and colleagues (on the global warming side of the debate) have suggested that the debate will be unresolved for a decade or more, as more data are collected and more analyses are conducted.

Interest groups have a great deal of power in such situations of scientific diversity, because they can selectively assemble experts on any given topic to basically support any ideological position. That interest groups will cherry-pick among experts comes as no surprise, but what, if any, responsibility do scientists have in such advocacy and what are the implications for the scientific enterprise?

From the perspective of the individual scientist choosing to align with an interest group, it should be recognized that such a decision is political. There is of course nothing wrong with politics. It is how we get the business of society done, and organized interest groups are fundamental to modern democracy. Nonetheless, an observer of this dynamic might be forgiven for thinking that different perspectives on scientific issues are simply a function of political ideologies. We often see how contentious political debates involving science can become, when filtering science through interest groups is the dominant mechanism for connecting science to policy.

It is this condition of dueling special interest scientists that leads to a second perspective: an institutional approach to providing scientific advice in a way that is not filtered through a particular special interest agenda. It is this very condition that gives legitimacy to government science advisory panels, National Academy committees, and professional societies. When scientists organize themselves to actively describe the policy significance of their work, it can serve to militate against the pathological politicization of science. Unfortunately, many such institutions eschew discussion of the significance of their work, or emulate the behavior of advocacy groups by presenting a subset of the relevant science.

One notable effort to place scientific debate into a policy context was led by MIT's Kerry Emanuel, a hurricane-climate expert embroiled in the current debate over hurricanes and global warming. He organized nine of his colleagues from both sides of the debate to prepare a statement about their debate and its significance for decision making. The statement by the scientists said:

> *As the Atlantic hurricane season gets underway, the possible influence of climate change on hurricane activity is receiving renewed attention. While the debate on this issue is of considerable scientific and societal interest and concern, it should in no event detract from the main hurricane problem facing the United States: the ever-growing concentration of population and wealth in vulnerable coastal regions.*

With the exception of The New York Times, the statement has been almost completely ignored by the major media and advocacy groups. This is not surprising, as many would rather use scientists for their own narrow purposes, which often depend on the presence of political conflict rather than consensus. Nonetheless, the effort by the hurricane scientists represents responsible leadership seeking to move beyond the exploitation of scientists for political ends.

Scientists who wish to avoid the effects of self-segregation by political orientation might consider the following advice:

- Affiliate yourself with interest groups with open eyes. Recognize what you are doing, and if it makes sense for you then go ahead and affiliate. You are of course acting as a political advocate. Not admitting to being a political advocate, or describing yourself as a focused only on the science, simply means that you are hiding your advocacy behind science.

- If you are concerned about the pathological politicization of your area of science, particularly in situations where there is a diversity of legitimate scientific and political debate, then demand that your public appearances take place in the context of diverse perspectives on science and policy. If you agree to participate in an event, a committee, a press conference, an assessment, etc. then look for people with different views than your own, and if you don't see them, ask that they be included.

Scientists have choices in how they engage with policy and politics. Self-segregation according to political predispositions is one of the easiest ways to make science both irrelevant to policy and deeply political.

The 2006 US Midterm Elections and Science & Technology Policy

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The 2006 United States midterm (i.e., between presidential) elections are historic, leading to only the second time in more than 50 years that control of the US House of Representatives will be handed over from one party to the other. The other change in majority occurred following the 1994 midterm elections which ended almost four decades of Democratic control of the House. In addition, the 2006 elections ended four years of unified Republican control of the US presidency and Congress, a situation which last occurred from 1953 to 1955. In the context of the war in Iraq and the looming 2008 presidential contest, the 2006 elections represent a major shift in US politics. But what, if anything, might they mean for issues of science and technology?

To be fair, I should note that I had the opportunity to work for a short time for the Democrats in 1991 on the staff of the House Science Committee under Congressman George Brown (D-CA). Seeing what happened to many of my friends and former colleagues when control of the House changed over in 1994 left a sour taste in my mouth, not simply for the Republicans led by Newt Gingrich (R-GA) who assumed power in 1995, but more generally for the arrogance of excessive political partisanship. I believe that the seeds of the current Republican loss are found not simply in the current policies of the Bush Administration (although, to be sure, this plays a big part), but more deeply in how Republicans have managed the Congress since 1994. With that "full disclosure" out of the way, here are some thoughts about the upcoming 110th Congress.

When I was in graduate school in the early 1990s working toward a Ph.D. in political science, it was popular to talk about the consequences of "divided government," which referred to control of Congress by one party and control of the presidency by the other party. For some political scientists, governance under divided government was considered not only inelegant but also inefficient, because it was so easy for one party to constrain the actions of the other. I recall reading many articles emphasizing the importance of united government. Since 2002, with united Republican control of the legislative and executive branches, discussion among political scientists of the perils of divided government appears to some degree to have waned and has been replaced with concerns over the perils of unified government.

As the United States once again enters a period of divided government, what consequences might we expect for issues related to science and technology policy?

First and foremost, we should expect more oversight. Oversight refers to efforts by the government to hold itself publicly accountable. One of the challenges of unified government is that there are fewer incentives for effective oversight of the executive branch by Congress. One reason for this is that the government does not always perform effectively or efficiently, so oversight can reveal evidence of poor governmental performance. As the 2006 elections indicate, poor governmental performance has implications for whomever the public favors in elections. In this context, a downside of oversight is that politicians use oversight to score political points with the public, and in the process may lose sight of good governance. Oversight is challenging in the best of circumstances, and this is made worse when political incentives are added to the mix. If there is one thing that we might expect from the 110th Congress, it will be greater oversight of the president and federal agencies.

Greater oversight will be a welcome change, as recent congresses have been derelict in their oversight duties. We should expect that a great deal of congressional oversight will be directed to US policies related to Iraq, and appropriately so. But there are also areas of science and technology policy where greater oversight is likely to occur, including issues such as the future of the Space Station, Space Shuttle, and NASA, stem cell funding policies, energy policies, climate policies, state science policies and federalism, academic earmarking, technology transfer, the fidelity of drug approval processes, government science advice, management of federal scientists who wish to speak out publicly, K-12 on up through postgraduate education, technology workforce issues, and the list goes on and on.

In fact, there is so much opportunity for congressional oversight that it will be very easy for the Democrats to lose their focus and completely waste the next two years. The 2008 election cycle, which will really begin in earnest in late 2007, will compress the time available to the 110th Congress to conduct effective oversight. It will also create incentives for more politically motivated oversight, such as on stem cell funding policies, in an effort to create an advantage for Democratic candidates in the 2008 election. A little of this posturing should be expected, but too much will be a wasteful distraction from implementing effective science and technology policies. Arguably the Republicans lost sight of governance during their run in Congress - the Democrats would be wise to note this lesson, but such wisdom is far from guaranteed.

In the first year of the new Congress, there will likely be those more extreme partisans on the Democratic side who will seek retribution for the past 12 years of Republican rule (particularly in the House). The transition that followed the 1994 Gingrich revolution left bad feelings with many Democrats, who had ruled continuously for decades (and, of course, created pent-up demands for retribution among Republicans). Acting like the Gingrich Republicans may be emotionally satisfying to some Democrats and their more fervent constituents, but it will not contribute either to effective policy making or to the future prospects for the Democratic leadership in Congress. One need only look to the 2006 elections to learn this lesson.

More speculatively, it is difficult to imagine dramatic changes in specific science and technology policies, or even much progressive legislation emerging from the House or Senate. Both chambers are only narrowly controlled by the Democrats, and thus will be governed by the middle, not the extreme. This diminishes the likelihood of radical policy change on issues of science and technology, which have always been characterized by a broad bipartisan support. On the other hand, a few pieces of novel legislation may emerge simply with the goal of forcing a veto of that legislation by President Bush - as for future Presidential candidates, it is never too early to be thinking about the 2008 campaign commercials. Stem cell funding policies and energy policies are two issues that might fit into this latter category. The 110th Congress will likely focus some attention on the issue of climate change. For instance, climate change is likely to see frequent congressional hearings. Such attention will keep the issue in the public eye and perhaps add to the likelihood that a particular Democrat will run for Congress. But as is often the case, it is far easier to talk about climate change than to implement effective policies (and not only in the US). It is unlikely that there will be any significant action or realignment on the issue in Congress and, of course, in a closely divided Congress the presidential veto precludes significant departure from business-as-usual in any case.

As far as funding for research and development, the status quo seems well entrenched. R&D has always enjoyed strong bipartisan support and this will not change in the 110th Congress. The macro-budgetary constraints have not changed and the war in Iraq and looming 2008 election probably rule out any significant change to US fiscal policies. So it is likely that Congress will do its best to fund science and technology, and the R&D lobby will find these efforts unsatisfactory.

Ultimately, congressional behavior on issues of science and technology may be important for what they tell us about politics more generally. Science and technology has always been an area with broad bipartisan support and collaboration. If science and technology policies become highly politicized and partisan, we should then expect confrontation and gridlock across the policy spectrum. Alternatively, effective collaboration on issues related to science and technology might just indicate that the promises of a new spirit of bipartisanship have some meaning to them. Time, and not much of it, will tell.

The Honest Broker

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When former US Vice President Al Gore testified before Congress last month he used an analogy to describe the challenge of climate change:

"If your baby has a fever, you go to the doctor. If the doctor says you need to intervene here, you don't say, "Well, I read a science fiction novel that told me it's not a problem." If the crib's on fire, you don't speculate that the baby is flame retardant. You take action".

With this example Al Gore was not only advocating a particular course of action on climate change, he was also describing the relationship between science (and expertise more generally) and decision making. In Mr. Gore's analogy, the baby's parents (i.e. "you") are largely irrelevant to the process of decision making, as the doctor's recommendation is accepted without question.

But anyone who has had to take their child to a doctor for a serious health problem or an injury knows that the interaction between patient, parent, and doctor can take a number of different forms. In my new book The Honest Broker: Making Sense of Science in Policy and Politics (Cambridge University Press), I seek to describe various ways that an expert (e.g., a doctor) can interact with a decision maker (e.g., a parent) in ways that lead to desirable outcomes (e.g., a healthy child). Experts have choices in how they relate to decision makers, and these choices have important effects on decisions but also the role of experts in society. Mr. Gore's metaphor provides a useful way to illustrate the four different roles for experts in decision making that are discussed in The Honest Broker.

The Pure Scientist

Seeks to focus only on facts and has no interaction with the decision maker. The doctor might publish a study that shows that ibuprofen is an effective medicine to reduce fevers. That study would be available to you in the scientific literature.

The Science Arbiter

Answers specific factual questions posed by the decision maker. You might ask the doctor what are the benefits and risks associated with ibuprofen versus acetaminophen as treatments for fever in children.

The Issue Advocate

Seeks to reduce the scope of choice available to the decision maker. The doctor might hand you a packet of a medicine and say "give this to your child." The doctor could do this for many reasons.

The Honest Broker of Policy Options

Seeks to expand, or at least clarify, the scope of choice available to the decision maker. In this instance the doctor might explain to you that a number of different treatments is available, from wait-and-see to taking different medicines, each with a range of possible consequences.

Scholars who study science and decision making have long appreciated that efforts to focus experts only on the facts, and to keep values at bay, are highly problematic in practice. As noted scholar Sheila Jasanoff has written: "The notion that scientific advisors can or do limit themselves to addressing purely scientific issues, in particular, seems fundamentally misconceived." How might this occur in practice?

Consider the *Pure Scientist* or *Science Arbiter* as described above. How would you view their advice if you learned that each had received $50,000 last year from a large company that sells ibuprofen? Or if you learned that they were active members of a religious organization that promoted treating sick children without medicines? Or if you learned that their compensation was a function of the amount of drugs that they prescribe? Or perhaps the doctor was receiving small presents from an attractive drug industry representative who stopped by the doctor's office once a week? There are countless ways in which extra-scientific factors can play a role in influencing expert advice. When such factors are present they can lead to stealth issue advocacy, which I define as efforts to reduce the scope of choice under the guise of focusing only on purely scientific or technical advice. Stealth issue advocacy has great potential for eating away at the legitimacy and authority of expert advice, and even a corruption of expert advice.

Then how does one decide what forms of advice make sense in what contexts? In *The Honest Broker* I argue that a healthy democratic system will benefit from the presence of all four types of advice but, depending on the particular context of a specific, some forms of advice may be more effective and legitimate than others. Specifically, I suggest that the roles of *Pure Scientist* and *Science Arbiter* make the most sense when values are broadly shared and scientific uncertainty is manageable (if not reducible). An expert would act as a *Science Arbiter* when seeking to provide guidance to a specific decision and as a *Pure Scientist* if no such guidance is given. In situations of values conflict or when scientific certainty is contested, that is to say most political issues, then the roles of *Issue Advocate* and *Honest Broker of Policy Options* are most appropriate. The choice between the two would depend on whether the expert wants to reduce or expand the available scope of choice.

So your child is sick and you take her to the doctor. How might the doctor best serve the parent's decisions about the child? The answer depends on the context.

» If you feel that you can gain the necessary expertise to make an informed decision, you might consult peer-reviewed medical journals (or a medical Web site) to understand treatment options for your child instead of directly interacting with a doctor.

» If you are well informed about your child's condition and there is time to act, you might engage in a back-and-forth exchange with the doctor, asking questions about the condition and the effects of different treatments.

» If your child is deathly ill and action is needed immediately, you might ask the doctor to make whatever decisions are deemed necessary to save your child's life, without including you in the decision making process.

» If there is a range of treatments available with different possible outcomes, you might ask the doctor to spell out the entire range of treatment options and their likely consequences to inform your decision.

The interaction between expert and decision maker can be complicated, and understanding the different forms of this relationship is the first step towards the effective governance of expertise. The central message of *The Honest Broker* is that we have choices in how experts relate to decision makers. These choices shape our ability to use expert advice well in particular situations, but also shape the legitimacy, authority, and sustainability of expertise itself. Whether we are taking our children to the doctor, or seeking to use military intelligence in a decision to go to war, or using science to inform climate policies, better decisions will be more likely if we pay attention to the role of expertise in decision making and the different forms that it can take.

The Honest Broker: Making Sense of Science in Policy and Politics, published by Cambridge University Press in April, 2007, http://www.cambridge.org/uk/catalogue/catalogue.asp?isbn=9780521694810.

From "Is it True?" to "So What?"

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Scholars who study the role of science in society have long appreciated how arguments about science become a proxy for political debate. Peter Weingart, of the University of Bielefeld, has described such situations as being "scientized" - where questions that are fundamentally about values are expressed in terms of competing factual claims or, more grandiosely, in terms of ultimate truth. And then political debate takes place about the truth or falsity of scientific claims. In such situations the question typically at the center of such a debate is, "Is it True?"

But while science provides a tremendously powerful way of looking at and shaping the world, in some situations it is fundamentally incapable of resolving claims to truth. First, as Prof. Weingart observes, political debates involving science often press right up to the frontiers of knowledge, where competing claims to certainty are most hotly debated among scientists and understandings remain contested. The ongoing debate over the role of greenhouse gas emissions on hurricane behavior provides an example of this dynamic. Daniel Sarewitz, of Arizona State University, offers a complementary perspective, observing that science does not provide a single view of the world, but rather a wide range of partial views from different disciplinary perspectives that do not "add up" to a coherent whole. For instance, Prof. Sarewitz suggests that plant geneticists who focus on improving agricultural productivity for human benefit view the risks of genetically modified crops differently than do ecologists who focus on protecting natural systems from human encroachment.

So then, what is true? Have hurricanes been intensified by global warming? Do genetically modified crops pose risks? Science simply cannot provide unambiguous answers to these questions. Of course the promise of science is that, at some point in the future, answers to these questions will be within our grasp, but meanwhile decisions about climate change and genetic modification need to be made.

When truth is elusive in political battles over science, a popular strategy has been to focus instead on the degree of agreement among experts as an indicator of truth. However, reaching agreement is a social process that involves far more than just science, and thus may reflect outcomes other than the truth. For example, an investigation of a US government drug approval advisory committee found that its individual members' views on a particular drug's safety could be predicted by whether or not they had received drug company support in the past. The climate science community has, with some considerable success, institutionalized a consensus perspective on climate science. But this success has come at the price of reducing freedom of inquiry - today anyone who challenges the consensus view on climate change risks professional ostracism and public attack.

One consequence of looking to agreement among experts as a surrogate for truth is that partisans in political debate seek to condemn and dismiss certain experts according to whom they may be associated with, rather than based on the content of their views. Not long ago I experienced this dynamic firsthand when an enthusiastic writer at "Gristmill," a widely read environmental advocacy blog, publicly sought to evaluate my views on science and politics based on the fact that I had been invited by Republicans in the US Congress to testify at a hearing on the Bush Administration's politicization of science. Had he actually read my testimony, he would have found some strong criticisms of the action of the current Republican administration. More generally, the substitution of ideological preferences for substance in evaluating expert knowledge is one of the risks of using agreement as a proxy for truth. In this way arguments putatively about "truth" can devolve to character assassination and worse, shedding little light on competing factual claims.

So if the question "Is it True?" can lead to unsatisfactory outcomes for both policy and science as a basis for resolving political debates, is there an alternative? I think there is, and the alternative is to focus instead on the question, "So What?"

In a 1904 lecture titled "What Pragmatism Means," William James proposed a thought experiment: Imagine a squirrel on the trunk of a tree, and a man standing on the other side of the tree trunk where he cannot see the squirrel. The man tries to circle the tree in order to look at the squirrel, but as he does so the squirrel moves round the tree, keeping the trunk between him and the man. They go around the tree several times in this way. James poses a question: Does the man go around the squirrel?

The answer depends on the frame of reference one chooses to impose upon the situation and, specifically, what it means to "go around." James used this example to illustrate how, for some questions of truth, answers often depend upon the practical implications of knowledge - what he called its "cash value."

A concrete example of this thought experiment can be found in the example of genetically modified crops suggested by Prof. Sarewitz. Judgments of "risk" in this context are a function of risks to whom or what - e.g., to human health and/or agricultural markets? Evaluated in what manner - e.g., via environmental precaution or cost/benefit analysis? These types of questions reflect how much pragmatic thinking has to offer in contemporary political debates that involve contested issues of science. Specifically, it forces us to ask "So What?" when confronted with contested knowledge claims, rather than "Is it True?"

Consider the policy of implementing effective hurricane policies - i.e., policies most likely to save lives and protect property. There are good reasons to think that it really does not matter whether or not greenhouse gas emissions have influenced hurricanes. If they have, there is exceedingly little that can be done to modulate the behavior of storms in the coming decades via energy policies. In any case, the most effective actions are likely to be adaptive and will make sense regardless.

When we ask "So What?" we are immediately forced to consider the values at stake, outcomes associated with those values, and the various paths available for achieving those desired outcomes. With a focus on values and outcomes, it becomes much more difficult to hide political debates behind science, and opens up discussion to a wider range of options to achieve shred goals, and also the possibility that political compromises might be reached regardless of the state of agreement on contested truth claims.

Those who expect that appeals to truth can resolve political disputes are likely to sense a frustrating circularity in pragmatic thinking because, for some issues, there simply is no resolution by an appeal to ultimate truth. Knowledge instead is provisional, negotiated, subject to revision, and not subject to verification. As Harvard's Sheila Jasanoff has written, we deal not with total truths, but with "serviceable truths."

So the next time you find yourself in a political dispute involving science, it may be tempting to try to convince your opponents of the truth (as they attempt the same approach with you). But when debates over truth prove unproductive, as they often do, you might also remember to ask "So What?" Perhaps political progress can still be made even if agreement on ultimate truths remains beyond our reach.

Late Action by Lame Ducks

Volume 15 | September 28, 2007

The administration of George W. Bush seems to have discovered a new interest in the issue of climate change, starting just before the G8 summit last summer in Germany. Common wisdom holds that this interest is either shallow or, more cynically, an effort to derail ongoing international negotiations via distraction. But when President Bush proposed that a new international framework for climate change be developed by the end of 2008, his last year in office, he had no trouble getting other world leaders to agree enthusiastically, and a first meeting is scheduled for this week in Washington.

The dynamics of late-term lame-duck presidencies (i.e., those ineligible to run again for office) suggest that the climate issue is indeed ripe for action at the end of 2008, especially if a Democrat is elected in November. These dynamics give at least some reason for thinking that action on climate change under the Bush Administration may not be so far-fetched a possibility.

It is quite likely that the political use of late-term regulatory action is one lesson that the Bush Administration surely learned from its predecessors. In 1995, under the Clinton Administration, the US Environmental Protection Agency (EPA) completed a report for Congress on mercury emissions, finding 1.6 million Americans potentially at risk from food contaminated by mercury pollution. But the EPA refused to release the report to Congress or to the public, claiming that it needed further scientific review. This drew the ire of several members of Congress, who argued that the report was being withheld because of industry pressure. One of the leading emitters of mercury into the environment is coal-fired power plants.

The EPA report was finally released in December, 1997, and the Clinton Administration continued its policy of inaction, if not obstruction, on mercury regulation. That is, until December 14, 2000, when the EPA abruptly announced a proposed rule that would cut mercury emissions by an impressive 90 percent.

What accounted for the sudden change from years of foot-dragging? One factor that certainly seems to have played a role is that on December 13, 2000 – one day earlier – the US Supreme Court decided that George W. Bush would be the 43rd president of the United States. The EPA could propose drastic regulations on mercury knowing that whatever negative political consequences would ensue, they would be borne by the incoming Bush Administration.

The proposed mercury regulations were a perfect political trap for the incoming president. The 90 percent reduction would be drastic enough to impose costs on important political constituencies. But if the regulations were to be scaled back, it would ensure headlines like the following: "Bush Administration Rolls Back Clinton Mercury Guidelines," which also would cast the administration in a bad light. Regardless of the merits of mercury regulation, the outgoing administration had guaranteed political problems for its political opponents.

Issuing such "midnight regulations" is a common practice of outgoing presidential administrations. Jimmy Carter put forward many in the last days of his presidency, anticipating the regulation-hostile Reagan Administration. Despite being criticized as hastily put forward, some midnight regulations have had a positive, even historic, legacy. For instance, one of President Carter's midnight regulations was the proposed regulation of chlorofluorocarbons that destroy the ozone layer, which ultimately led to US participation in the Vienna Convention and, subsequently, the highly successful Montreal Protocol.

A 2005 paper in Presidential Studies Quarterly by William Howell and Kenneth Mayer finds that "having lost in November, presidents usher through the regulatory process roughly 25 percent more rules and directives during the final three months of their terms." The effect is much larger when the White House changes hands from one political party to another.

There is little doubt that the Bush Administration felt the political sting of not only the proposed mercury regulation but other last-minute actions by the Clinton Administration as well, such as those on arsenic and the International Criminal Court.

So if a Democrat is elected in November 2008, which appears likely, it seems eminently plausible that the Bush Administration would help the new administration get off to a running start by leaving them with a proposed rule, under the EPA, for the regulation of carbon dioxide emissions. Even the possibility of such a late-hour action is probably enough for the declared Democratic presidential candidates to be very careful about calling for dramatic action on climate change, lest – if elected – they find themselves getting what they asked for.

Because no one really yet knows how to reduce carbon dioxide emissions by any significant amount, a strong proposed rule on climate change issued in the final months of the Bush Administration would create all sorts of political difficulties for the next president, just as those late-hour rules proposed by President Clinton did for President Bush. If reducing emissions indeed proves to be easy, as some have suggested, President Bush would get credit for taking decisive action. If it proves difficult and costly, as many suggest, then the next administration would bear the political backlash.

Common wisdom that the Bush Administration will not act meaningfully on climate change may in the end prove to be correct. But, at the same time, remember that lame ducks are unpredictable creatures.

Technology Assessment and Globalization

Volume 16 | December 2007

Fresh sushi, it seems, can be found almost everywhere. Such casual observations of contemporary trends in the globalization of food are backed up by data. Our insatiable appetite for fresh fish has had a profound effect on world fish stocks. In 2006 a study published in Science estimated that 29 percent of all fished ocean species were being harvested unsustainably. As the world struggles to cope with the many challenges of globalization, which include protecting fish populations in the face of enormous demand, it is of particular importance to understand the role of technology in globalization and the role of technology assessment in our efforts to manage the effects of globalization.

According to Sasha Issenberg's fascinating exploration of the global sushi industry, The Sushi Economy[1], the main people interested in catching mature western Atlantic bluefin tuna in the 1960s and early 1970s were sport fishermen looking for trophies. After documenting their catch they would dispose of the worthless fish, or if they were lucky, sell it for about five cents per pound to be processed into pet food. But everything changed in the early 1970s when Japan Airlines sought to fill the empty cargo holds of its jumbo passenger jets returning to Japan after bringing full shipments of electronics and other consumer goods to North America. A JAL employee named Akira Okazaki was given the challenge of finding appropriate goods to ship back to Japan, and he quickly zeroed in on the bluefin tuna found off the northeast shores of the United States and Canada.

There was one big technological obstacle to overcome: Tuna was valuable in Japan when fresh, but shipping the large fish packed in ice was prohibitively expensive due to the weight. But with necessity the mother of invention, it was not long before innovations in freezing, packing, and shipping technologies enabled a new market opportunity in the trade of bluefin tuna from the North Atlantic. The first North Atlantic tuna sold in Tokyo's Tsukiji Fish Market on August 14, 1972, were purchased for $18 per pound, 50 percent higher than the shipping costs. In 2001, a 444-pound North Atlantic tuna sold for $175,000, or close to $400 per pound, an 800,000 percent price increase from the five cents per pound paid in the 1960s. Tuna would be pet food no more.

With the globalization of sushi involving so many fascinating aspects of culture, economics, and history, it would be easy to overlook the enabling role of technological innovation. But without the invention of a way to move fresh fish around the world, the fishing pressure on the stock of North Atlantic tuna would certainly have developed differently from the 1970s to the present. Low-technology innovations in freezing and packing associated with shipping seafood around the world led to profound impacts on culture, markets, and the environment around the world. These effects were the indirect consequence of a trade opportunity made possible by the North American demand for Japanese technological innovations in consumer electronics. When my parents brought home our first color television in the early 1970s, they could not have envisioned that they were contributing in a small but significant way to forces of globalization that 30 years later have resulted in their grandchildren asking me for sushi as a treat from our local grocery store.

Technology assessment, as conventionally understood, involves developing some understanding of the future trajectory of technological innovations on matters of societal concern. This was explicit in the original legislation of the US Office of Technology Assessment (OTA), which defined technology assessment as providing "early indications of the probable beneficial and adverse impacts of the applications of technology."

But such foresight is simply not possible for many technologies and contexts, in part because no one is paying attention to what, in hindsight, turn out to be important innovations, and also because technologies shape the future in fundamentally unpredictable ways. In his 1973 presidential address to the American Historical Association, historian Lynn White, Jr. suggested that technology assessment carried a defect in the "lack of a sense of depth in time." White provided many examples from the distant past. He explains how the invention of the chimney and flue contributed to class divisions of the later Middle Ages by enabling a fireplace in every room, thus allowing the wealthy to distance themselves from their servants. He also explains how the invention of the button changed how people viewed children in the later 16th and early 17th centuries. The button enabled more tightly fitting clothes and a corresponding reduction in pulmonary infections, dramatically lowering infant mortality, and increasing the attention that adults invested in children.

Examples of connections between seemingly innocuous innovations and global consequences are everywhere. In a fascinating study that might be characterized as forensic economics, M. Scott Taylor of the University of Calgary argues that a European innovation in the tanning of animal hides led directly to the slaughter and near extermination of the American Bison (or buffalo) in the latter part of the 19th century. Much like North Atlantic tuna, buffalo were once prized only as trophies. After being killed by hunters, their carcasses were typically left to rot on the Great Plains because their hides were not amenable to tanning for leather.

But when European demand for industrial leather grew, necessity once again was the mother of invention, and a new approach to tanning hides was sought and found. The ability to turn buffalo skins into leather led to an enormous demand in Europe, a corresponding increase in the price of buffalo hides, and a correspondingly dramatic increase in killing buffalo and exporting their skins, so much so that 30 million buffalo were hunted almost to extinction over a period of less than a decade. Aspiring technology assessors of the 1870s would have been hard pressed to notice, much less to anticipate, the effects of innovation in the European leather tanning industry before serious environmental consequences resulted on the North American continent.

Ultimately Lynn White, Jr. was concerned that we "illuminate the limitations as well as the possibilities of assessing technology." One of the most important limitations may be that most technology assessment, at least as defined by the US OTA, is simply impossible. The stories of the tuna and the buffalo are a century apart, but they tell us some very important things about our efforts to manage technology in a globalizing world. Among these lessons: the processes of globalization are not new, their effects have always been fast in comparison to our ability to respond, and our ability to foresee the effects of technological innovation on our world are profoundly limited. Exploring the implications of these realities for understanding the role of technology in globalization, and for assessing technology to aid our efforts to manage the effects of globalization, increasingly occupies my scholarly interests and will be a frequent topic of my future writings.

References

1. http://www.thesushieconomy.com

Blinded by Assumptions

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In a 1991 evaluation of the usefulness of policy research Ronald Brunner wrote that "most preventable errors of policy analysis stem from the analyst's perspective; as the analyst simplifies a problem to make it tractable for analysis and action, some important part of the relevant context is misconstrued or overlooked altogether." Errors in policy analysis, Professor Brunner tells us, can have real-world effects. "The analytical error – what is misconstrued or overlooked – becomes apparent only in retrospect, after resources have been committed and the unintended and often adverse results start coming in."

Policy analyses related to the mitigation of and adaptation to climate change demonstrate how an incomplete or misleading perspective can warp how we think about policy options. For instance, in early April, Tom Wigley, Chris Green, and I published a commentary in *Nature* that examined assumptions underlying scenarios of future carbon dioxide emissions, and what these assumptions imply about the level of effort needed to stabilize concentrations at some desired level in the atmosphere. These assumptions are based on expectations of future technological innovations that will result in an automatic decarbonization of the global economy, with "automatic" meaning that no specific climate policies need to focus on meeting the challenge of stabilization. Under such assumptions, future emissions of carbon dioxide are expected to increase more slowly than either the increase in the global use of energy or the growth in the size of the global economy.

Automatic technological innovation would be good news for those seeking to stabilize atmospheric concentrations of greenhouse gases. If the global economy spontaneously decarbonizes, then it reduces the magnitude of the mitigation challenge. But if carbon dioxide accumulates in the atmosphere at a faster rate than has been assumed, then the challenge of mitigation would obviously be much larger. Unfortunately, in the first decade of the 21st century the world appears to be *recarbonizing* rather than decarbonizing the global economy, contrary to the assumptions that underlie assessments of the magnitude of the mitigations challenge, including those published by the Intergovernmental Panel on Climate Change. One reason for the rapid growth in emissions is the unexpected pace of fossil fuel-intensive development in Asia, and in China in particular. Some scholars believe that the rapid pace of growth will continue for decades.

Our paper argues that we should (a) be aware of the assumptions of spontaneous technological innovation in virtually all scenarios of future emissions, and (b) also recognize that current trends are unfolding in a manner quite different than was assumed. One implication of our paper is that policy makers should consciously reflect on the full scale of the technological challenge of mitigation, rather than assuming that some large part of that challenge will be met spontaneously. Initial reactions to our paper have been interesting; with some resisting the call to critically examine earlier assumptions. One reason for this resistance is undoubtedly that political commitments are built upon the justifications in policy analyses.

Calling into question policy analyses may necessitate rethinking aspects of the political debate, which is never easy, but is especially difficult in the context of the highly politicized arena of climate change.

Adaptation analyses suffer from a similar influence of assumptions on policy discussions. For example, most assessments of the potential future impact of climate changes on disaster losses begin by assuming that the climate will change while society stays exactly as it is today. This is a very useful approach for exploring the sensitivity of today's society to changes in climate, but can be very misleading when regarded as a prediction of future climate impacts. One example of such a study is found in a 2005 report of the Association of British Insurers, which discussed the future impacts of tropical cyclones (including hurricanes) in the context of climate change. The report concluded that climate change could result in a 65 percent increase in future losses over today's values. This sounds like a large increase, but what the report did not share with its readers is that if various projections for future population changes and economic development had been included, the increased exposure would also lead to increasing losses. And these losses would be *5 to 12 times larger* (depending on assumptions) than those resulting from the climate changes.

Across other areas of climate impacts research, such as sea level, disease, and farming, analysts routinely assume that society will not change as the climate does. This serves to magnify the effects of climate change on society, diminish the potential value of adaptive response, and completely ignore the societal factors that are the most significant drivers of future climate impacts. The effect of such assumptions of a static society has been identified in some areas; for instance, scholars have ridiculed the idea of "dumb farmers" who fail to adapt to changing climatic conditions. But familiar assumptions are hard to displace, especially in the context of a climate change policy debate that has long been tilted towards mitigation over adaptation.

The mitigation and adaptation examples cited above indicate how important it is that we be aware of the assumptions that underlie our policy analyses and also our related policy preferences. The topic of climate change is by no means unique in this regard. Consider the quantitative assumptions made in areas such as subprime mortgage risk (and plenty of other areas of finance), the number of weapons of mass destruction stored in Iraq, government budgeting, and so on. One of the most important roles that policy analysts can play - whether they work in public view or for a private enterprise -- is to bring assumptions into the open, question them, and suggest how we might think differently.

But this also means that the policy analyst may be an unwelcome participant in political debates. Questioning assumptions can also lead to questioning the policy recommendations justified by the analyses built upon those assumptions. Effective leadership will support policy analyses, even if the results might be unexpected or unwelcomed. Not all errors of policy analysis are preventable, but as Professor Brunner warns us, those that are can usually be traced to being blinded by our assumptions.

Has Technology Assessment Kept Pace with Globalization?

Volume 18 | July 1, 2008

Right now, in the area of energy policy, decision makers are debating a number of important but complicated questions. For example, various perspectives are offered on the effects of biofuels mandates on global food prices; OPEC and the United States are presenting vastly different projections of gasoline demand in the 2020s based on differing views on the future adoption of renewable energy technologies; and the US Congress is considering implementing laws to regulate speculation on future commodity prices in global financial markets in the context of vastly different perspectives on the effects of such speculation on current energy prices.

A characteristic that is common to each of these areas of policy debate is uncertainty, or perhaps more accurately, competing claims to certainty, usually offered by those with a stake in the outcome of the debates. In today's ever-globalizing world, the effects of technologies - such as biofuels, renewable energy technologies, and financial instruments - are far-reaching and hard to see. Unintended consequences are to be expected. In this context, decision makers would benefit from an authoritative, independent perspective on technology assessment. Unfortunately, such capabilities do not appear to have kept pace with globalization and its consequences.

Of course, the challenges of globalization are not new. Not long ago in this space I discussed a very interesting paper by M. Scott Taylor of the University of Calgary who argued that a European innovation in the tanning of animal hides led directly to the slaughter and near extermination of the American bison in the latter part of the 19th century. One could follow a similar approach to tracing technological reverberations through governments and markets to ask whether early 1980s policy responses to technological advances in crop production led directly to the emergence of Mad Cow Disease in the United Kingdom.

During the 1970s, farm productivity increased dramatically around the world due primarily to technological innovations in agriculture. In the United States, increasing productivity coupled with government production subsidies resulted in a supply of commodities that exceeded demand. The outcome was lower food prices and corresponding financial hardship for many farmers. Of course, no government likes to see its farmers suffer any financial hardship, so in January 1983 President Ronald Reagan announced a new farm policy designed to pay farmers to take certain crops out of production, in order to stimulate higher prices for commodities and thereby boost the incomes of US farmers.

The effects of the policy were large and immediate. By the end of 1983, the US Department of Agriculture estimated that US production of corn would drop by 49 percent from the year before, with rice dropping by 33 percent and wheat by 20 percent. Although soybeans were not covered by the payment program, their production decreased by 33 percent as well because many farmers not covered by the payment program shifted their planting to the now higher-priced corn and wheat. The reductions in crop production were exacerbated by a widespread drought during the 1983 growing season.

In the global marketplace, the decrease in US soybean production led to increased costs not just of soy meal - used as animal feed - but also of fish meal, which also served as animal feed. One result of the increased costs of imported soya and fish meal in the United Kingdom was an immediate increase in the proportion of lower cost meat and bone meal used in cattle feed -- from 1 percent to 12 percent of the total (a contributing factor to the increased costs of imports was also the weakness of the UK pound in international currency markets). Much later, after Mad Cow Disease became of wide concern and led to a scandal in the UK government, it was learned that the epidemic had its origins in the meat and bone meals used in cattle feed.

There is a general pattern here. In the case of the near-extermination of the American bison, European wars created demand for leather which was the necessity that mothered the invention of techniques for tanning the bison hide. The technological advances and their deployment stimulated a market demand with effects that were immediate and merciless. Similarly, technological advances in agricultural production in the 1970s, when coupled with generous domestic farm subsidies, led to the production of crops at a rate that exceeded demand. The US policy response to this situation was to take action to reduce the supply of crops in an effort to boost prices and benefit domestic farmers. This action worked in the short term, but it also set loose a domino effect of consequences through the global economy, creating an economic incentive for a large shift in the content of cattle feed in the United Kingdom, which led directly to the conditions that caused an epidemic of Mad Cow Disease.

Of course, the fate of the bison was certainly far from the minds of 19th century European military leaders, and cattle feeding practices in the United Kingdom were of no concern when Ronald Reagan sought to boost the incomes of US farmers. But given the profound changes that technology wreaks on society - and the potentially far-reaching effects of policies seeking to respond to the effects of technology - what can decision makers do to better manage the consequences of technological change? Whose responsibility should it be to assess the unintended consequences of technologies in a globalized world?

As we see the dramatic effects of technology-related decisions reverberate around the world today, it may be time to develop an international technology assessment capability that is independent and authoritative in order to inform current debates. The alternative is that policy makers will rely on competing claims to certainty, or worse, simply take actions with little understanding of either causes or consequences.

The Role of Risk Models in the Financial Crisis

Volume 19 | October 16, 2008

"Our 21st century global economy remains regulated largely by outdated 20th century laws." This was one of the explanations for the financial crisis given by President George Bush in his address to the nation on September 24, 2008. While the full reasons for and details of the still-unfolding crisis will certainly be explored in depth, one important aspect of the crisis has yet to receive the attention it deserves: the notion that regulation of the 21st century economy requires 21st century technologies in the form of highly complex financial risk models. When the story of the current financial crisis is told in full, I expect that the misuse of risk models will be found to have played an important role.

Risk models can be valuable tools in the financial industry. But there are two significant problems with their use in financial decision making. One is that risk models break down in times of crisis. Jón Daníelsson of the London School of Economics explained this dynamic in a 2000 paper appropriately titled "The Emperor has No Clothes: The Limits to Risk Modelling": "The basic statistical properties of market data are not the same in crisis as they are during stable periods; therefore, most risk models provide very little guidance during crisis periods." The same models that make sophisticated financial instruments possible during normal times are virtually useless during times of crisis.

A second problem is that the use of risk models encourages a herd mentality among firms. According to an Inspector General's report from the US Securities and Exchange Commission released September 25, 2008, "In times of market stress, trading dries up and reliable price information is difficult to obtain. Models therefore become relatively more important than market price in times of market stress than in times when markets are liquid and trading actively. Such stressed circumstances force firms to rely more on models and less on markets for pricing and hedging purposes." Daníelsson observes that the wide reliance on risk models to make decisions in a crisis can lead to perverse outcomes: "If . . . identical external regulatory risk constraints are imposed, regulatory demands may perversely lead to the amplification of the crisis by reducing liquidity." To have many large institutions making bad decisions with flawed information is not a recipe for financial stability.

In our 2000 book on the role of geophysical predictions in decision making (*Prediction, Science, Decision Making, and the Future of Nature*, Island Press, 2000) we developed a set of guidelines indicating when to rely on predictions in decision making. The criteria are met when (1) predictive skill is known, (2) decision makers have experience in understanding and using the predictions, (3) the feedback loop between use of the prediction and evaluation of that use is relatively short (such that it can feed back into future decisions), (4) there are limited alternatives to relying on prediction, and (5) the outcomes of decisions based on predictions are highly constrained (in other words, the magnitude of the consequences of decision error is limited).

In the current financial crisis, it appears that each of these guidelines was violated: (1) decision makers have little understanding of the predictive skill of their models. For instance, in a 2008 paper on the role of risk models in the financial crisis, LSE's Daníelsson cites a Lehmann Brothers' modeler commenting on model performance during the summer of 2007: "Events that models predicted would happen only once in 10,000 years happened every day for three days." (2) Decision makers had little experience in using the complex risk assessments. This was revealed dramatically during the spring of 2008, when the *Financial Times* reported that an error in a model used by Moody's, one of the world's most respected and widely utilized source for credit ratings, research and risk analysis, led to a far higher credit rating than was deserved by a particular complex derivative product. Upon learning of the error, Moody's adjusted the model to reflect the ratings error, rather than admit the initial mistake. Because no one had any experience with the sophisticated financial product being modeled, the presence of the error in the rating virtually escaped notice in the marketplace.

One could argue that the various failed institutions in the current crisis provide a good example of exactly the sort of (3) feedback that results when risk assessments are in error. But such feedback is a lot like learning how to design and fly the space shuttle through trial and error: Surely it can be done, but it comes at a high price. Learning about risk models through their deployment throughout the financial system is a similarly risky practice. (4) Effectively using models of complex, open systems usually means treating them as one of many approaches to assessing risk. The Inspector General of the SEC has recommended that the SEC be "more skeptical" of risk models and that firms be required to develop "informal plans" for scenarios that may not be found in their models. In other words, they should use models heuristically and not as comprehensive tools for assessing risks. (5) The current financial crisis will have effects that are felt for years, perhaps longer, with consequences that are not fully understood.

Risk models are an important tool and no doubt here to stay as a fundamental part of our 21st century global financial system. But wisdom will be found in using them effectively. As LSE's Daníelsson explains:

> *The current crisis took everybody by surprise in spite of all the sophisticated models, all the stress testing, and all the numbers. The financial institutions that are surviving this crisis best are those with the best management, not those who relied on models to do the management's job. Risk models do have a valuable function in the risk management process so long as their limitations are recognized. They are useful in managing the risk in a particular trading desk, but not in capturing the risk of large divisions, not to mention the entire institution. For the supervisors the problem is even more complicated. They are concerned with systemic risk which means aggregating risk across the financial system. Relying on statistical models to produce such risk assessments is folly. We can get the numbers, but the numbers have no meaning.*

Using risk models effectively in the 21st global financial system will require the widespread use of a decidedly pre-21st century tool - common sense.

An Interview with John H. Marburger, Outgoing US President's Science Advisor

Volume 20 | December 22, 2008

"John H. "Jack" Marburger has served as science advisor to President George W. Bush from 2001 to the present, making him the longest-serving science advisor since the position was established in 1957. Now in the final weeks of the Bush Administration, Dr. Marburger has graciously agreed to answer a few questions about his accomplishments, the science advisor's role, and the politicization of science.

You can see my 2005 interview with Dr. Marburger, as well as interviews with six other previous science advisors, at this web site:

http://sciencepolicy.colorado.edu/scienceadvisors

These interviews, along with several analytical and historical essays, are the basis of a new book on presidential science advice that I co-edited with Bobbie Klein, which will appear in 2009.

Interview with John H. Marburger
December, 2008

What do you see as the most significant legacies of your term as science advisor?

My OSTP [Office of Science and Technology Policy] colleagues and I worked to maintain US leadership in science and technology into the future. We worked on so many issues that it is hard to pick the "most significant." They were all significant to some sector of the economy or the science community or they wouldn't have reached the White House level. A short list would include: helping to establish a science agency within the Department of Homeland Security, working to prevent the reaction to 9/11 from undermining our participation in global science (student visas, "science vs security" issues), helping to develop a rational vision for space exploration, responding to international challenges to US leadership in high-end computing, preserving the independence of Internet governance, freeing up large blocks of the broadcast spectrum for commercial wireless applications, negotiating IPCC [Intergovernmental Panel on Climate Change] assessment reports that could form the basis for US climate policy, getting action on a Next Generation Air Transport System, developing Executive Orders on Aerospace R&D, Broadband, Manufacturing R&D ... The list is very long. We played a major role in developing the president's American Competitiveness Initiative (ACI) and significant roles in energy-related initiatives including ITER [International Thermonuclear Experimental Reactor], Hydrogen, Advanced Energy Initiative, and the Climate Change Technology Program. I am also pleased at the response to my plea for a strengthened "science of science policy."

What advice do you have for your successor?

Hire good people, insist on the highest technical quality of all work that comes through the office, and confine your advice to technical issues, not veering onto the turf of other policy shops without a technical reason to do so. Respond quickly to requests for advice from any source, and make sure work products are synchronized with the budget cycle or the deadlines of the "customer." Deliver the advice in language the user can understand, and don't make it too long.

What advice do you have for the US scientific community for interacting with the highest levels of government?

Only a few scientists are likely ever to interact with "the highest levels of government," and what is most effective depends on whom you interact with and what the topic is. I recommend reading some good books on the subject of science advice, my favorites being Bruce L.R. Smith's *The Advisers: Scientists in the Policy Process*, and Dan Greenberg's Science, *Money, and Politics: Political Triumph and Ethical Erosion*. I also recommend Aaron Wildavsky's *The Politics of the Budgetary Process*. Recently I recommended your book, *The Honest Broker*, to an audience of scientists. Its academic style makes it harder to read than the others, but it has important ideas that scientists should know about. Scientists are most effective as members of advisory committees, and least effective when they engage in electoral politics. In between these roles is a wide spectrum of behaviors that diminish in impact in proportion to their increasing distance from technical expertise.

What do you see as the outcome of the battles over the "politicization of science" that took place during the past eight years?

I think these "battles" had very little long-term significance. A more serious problem is the exploitation of science by anyone and everyone who has something to sell, whether it's a product, a program, or a point of view. Everyone wants their argument to be backed up by "science," so we see marketing or advocacy language that redefines issues to look like science issues whether they are or not. Your book describes this phenomenon in a political context, but it's really a marketing strategy that applies to all kinds of products.

One of your important legacies is the creation of an initiative on the Science of Science Policy. What are your hopes for its continued development and role in science policy decision making?

My vision for the science of science policy is that it might become an academic field of study with its own status within the social sciences, complete with degree programs, endowed chairs, journals, conferences, and an accumulating literature. The idea is to provide a much stronger empirically oriented context of theory and data for science policy making. The field would produce both scholars and practitioners who would help make new tools and findings available to decision makers, raise the quality of science policy discussions, and narrow options for prioritization. Policy makers in public health, finance, labor, and other economic fields seem to have a much richer context for supporting decisions in their fields than science policy makers do. Given how much our society spends on research and development, science and technology decision makers deserve similar support. Existing science policy studies tend to be *ad hoc*, non-cumulative, and weak on empirical validation. Part of this is owing to lack of data and accepted theoretical structures, and these are missing because of the small community of science policy makers it serves and the expense of defining and gathering the needed data. There has not been a strong "market pull" for improved science policy tools. I think the market is there and growing, and new information technology capabilities make this a good time to build new tools. I say more about this in an OECD [Organization for Economic Cooperation and Development] publication, *Science, Technology and Innovation Indicators in a Changing World: Responding to Policy Needs* (OECD Publishing (2007); Chapter 2: "The Science of Science and Innovation Policy," page 27).

What do you hope to see in future international collaborations on science and technology policy?

Today's major economies are "globalized," and they have a strong technology component. Consequently, science and technology policy - usually coupled with "innovation policy" - has become more important in international affairs. Policies on technical workforce development, for example, cannot ignore the global mobility of work and workers. Empirically validated policies, therefore, require comparable data from many different nations. That cannot be achieved without strong international collaboration on data definitions. The OECD can play an important role in encouraging such collaboration, and in promulgating best practice. Their success depends on a larger activity where scholars from different countries collaborate on specific case studies and related work. I hope to see such collaborations supported by the major science-sponsoring nations.

Obama's Climate Policy: A Work in Progress

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Leaders around the world have come to agree that the continuing accumulation of carbon dioxide in the atmosphere poses risks requiring action. But as the Obama Administration is learning, accepting the need for action and actually implementing effective carbon policies are two different things.

The Obama Administration favors an approach called cap and trade, which establishes a cap on total emissions and sets up a market to buy and sell emissions allowances under the cap. The theory is that, as the binding cap declines over time to some target value, the market will determine the most efficient manner of reducing emissions.

In such a market, someone has to receive the initial revenue associated with creating a market where none existed before. Rather than handing this over to emitters, the Obama Administration sees the new revenue as a timely and welcome contribution toward its goal of reducing the size of the federal deficit. Predictably, this has already started a debate in the US Congress over cap and trade as a new and regressive tax.

But what has gone largely unmentioned thus far in the emerging debate over cap and trade is the fact that the Obama Administration's goal of reducing US emissions by 14 percent from their 2005 values by 2020 (to about 5.1 gigatons of carbon dioxide per year) is almost certainly unachievable without compromising economic growth. Policy makers, to be sure, won't trade emissions reductions for economic growth. Thus, with cap and trade, the Obama Administration runs the risk of establishing an enormously complex new program that does many things - but appreciably reducing emissions will not be among them.

Here is the reason, and emissions math is not complicated: According to the US Energy Information Agency (EIA), in 2007 the US generated nearly 6 gigatons of US carbon dioxide emissions from three fossil fuels: coal, natural gas, and petroleum. Each of these fuels, plus renewables and nuclear power, contributed to the total national energy consumption, which in 2007 was 101.4 "quads" (a quadrillion British Thermal Units). The EIA projects that the US will need 108.6 quads of energy in 2020.

To supply this much energy in 2020, while meeting a target of 14 percent reduction in emissions, is highly unlikely. Consider that the target could be reached if coal consumption were reduced by about 42 percent, being replaced by renewables plus nuclear energy. But this would imply more than a doubling of the supply of renewable plus nuclear energy. Due to the challenges faced in establishing new nuclear plants, this alone seems impossible to achieve in the next 10 years. However, scaling up renewables may be even more daunting. If we assume that the nuclear power supply doubles between now and 2020, wind and solar would have to increase their role in supply 80-fold over current values to make up the difference. The Obama Administration's goal of doubling wind, solar, and biofuels production in three years may indeed be a worthwhile policy - but it is not compatible with a goal of displacing sufficient coal to reach the 2020 target.

What about reducing energy use? To meet the 2020 target through efficiency gains, energy consumption would have to be about 85.5 quads in 2020, or about equal to 1992 values when the US economy was 35 percent smaller. This represents a reduction of about 2 quads per year in US energy use over the next decade. Assuming that policy makers and citizens want economic growth to resume, this is a Herculean task.

Smart people with spreadsheets conduct more sophisticated exercises than the ones I have presented above, introducing a large range of assumptions about energy prices, production, and use, and seeking some combination of outcomes that will result in a 14 percent reduction. But none of these exercises makes the task easier than is outlined in the hypothetical scenarios above - just more complicated. Complexity can obscure the fact that a cap and trade approach to emissions reductions depends a great deal on hopes that emissions can, in fact, be reduced at the rate needed to meet the desired target. If they cannot, policy makers will turn to "safety valves," carbon offset schemes and anything that will loosen the cap so it does not adversely affect economic growth.

An alternative approach to carbon policy would focus explicitly on how to make economic growth compatible with decarbonization. Specifically, rather than advocating the very indirect approach of cap and trade, a direct approach would focus explicitly on the rapid advance of efficiency gains coupled with a long-term goal of transitioning to carbon-free energy.

A policy focused on sustained improvements in energy efficiency might learn from the Japanese, who have become the most energy-efficient major economy by identifying the most efficient companies within industrial sectors, setting a benchmark at the level of the best performers, and creating incentives/regulations to compel efficiency gains across the sector. At the same time, they are continuously advancing the frontier of benchmarked efficiency through a large commitment to ongoing technological innovations. In a similar way, US policies could be directly focused on increasing carbon-free energy supply as a matter of long-term national industrial policy.

If progress toward efficiency gain coupled with an increasing supply of carbon-free energy occurs at a rate faster than economic growth, then emissions will necessarily be reduced. A carbon policy that focuses directly on the factors that lead to emissions reductions - and not the outcome, with hopes that some complex policy design can somehow make the impossible possible - offers the greatest hope for real emissions reductions over the coming decades.

An effective carbon policy will also require humility. No developed country has decarbonized its economy at a rate of more than about 1-2 percent per year for any length of time, including those who have signed on to Kyoto and those who have implemented even more aggressive climate policies. Thus, no one really knows how fast a major economy can decarbonize, or what measures will actually work. Given that policy makers are moving into the policy unknown, every policy put into place will be an experiment. Some will work while others will not. Setting grandiose long-term goals with fantasies about specific targets and timetables is a distraction and will likely set back the task of reducing emissions.

The Obama Administration is currently learning many of these lessons as its climate policy aspirations are engaged in the emerging Congressional debate. Whether these lessons will result in a healthy evolution of policy proposals remains unclear. What is clear is that Obama's climate policies are a work in progress.

First Reflections from a Workshop on Science Policy Research and Science Policy Decisions

Volume 22 | July 17, 2009

In May, 2009, I co-organized a workshop with Merle Jacob of the University of Oslo on the role of science and innovation policy research in making science and innovation policy decisions. The workshop, sponsored by the US National Science Foundation (NSF) and the Norwegian Research Council (NRC), was held at the NRC headquarters in Oslo during a few beautiful sunny spring days. Attended primarily by scholars and decision makers from the United States and Norway, it also included a few scholars from the United Kingdom and Sweden. Here are a few of my early reactions from that workshop.

First, the relationship between research on science and decisions about science appears to be gaining more attention in the US and Norway, as well as more broadly across Europe. In the United States, the NSF has a program in this area (called the "science of science and innovation policy" or SciSIP) and a broader cross-agency program called Science of Science Policy (SoSP). The Norwegian Government recently prepared a white paper on the "Climate for Research" that, among other things, recommends that research policy evaluation should move from a focus on inputs - such as budgets for research - toward a focus on what research contributes to society. The EU has recently released a number of reports on science policy that explicitly seek to apply science policy research to science policy practice.

Second, in spite of increasing attention to the topic of "science of science and innovation policy" the area remains somewhat of a Rorschach test, even for scholars who self-define their work in this area. For instance, even within the United States there is no shared terminology to describe this area of research, much less among scholars across the Atlantic. Scholars from research areas self-described as science policy, technology policy, research policy, innovation policy, science and technology studies, as well as traditional physical and social sciences and humanities disciplines, lay claim to doing work on the "science of science and innovation policy." This interdisciplinary cross-fertilization can be a very good thing, but it carries with it the common risks facing interdisciplinary research, such as the lack of a shared understanding of purpose or methodologies which may result in less-than-rigorous work.

Interestingly, scholars from outside this general community could rightly claim to be doing this sort of work. One of the cases we examined was climate research: Here there is considerable discussion about the role of research in decision making, but many scholars are not at all engaged with the community of science and technology policy research or science and technology studies. Better integration of such topical communities with those more historically focused on science and technology as an object of study would benefit both communities.

Third, despite a seeming consensus in the community that a focus on "indicators" does not do justice to the complex relationship between research and the societal outcomes related to research, the community maintains a magnetic-like fixation on identifying indicators of relevance. The focus is on inputs such as funding for various areas of science, as well as outputs such as patents, publications, and citations. Equally irresistible is the urge to engage in cross-national comparisons, with each country's science policy makers looking for ways to show how their nation is somehow falling behind the competition. In the United States, those advocating for more funding for science like to use the metric of government research investment as a proportion of GDP - which invariably shows the US falling behind. Similarly, when pointing to the excellence of their own national research, science policy makers like to employ whatever metric creates the best impression, whether it be citations per quantum of research funding, or citations per paper, or some other metric that makes their case. It seems that we have a ways to go if we are to move beyond a narrow focus on indicators and metrics.

Fourth, even as science policy decision makers appeal to cross-national comparisons to gain the advantage in domestic debates over resource allocation, one of the most surprising things about our workshop was the ease with which scholars of science and innovation shared a common set of norms and perspectives. Part of this, of course, reflects the fact that Merle and I selected the participants (who were mostly, but not exclusively social scientists and humanists). But academia today is so thoroughly globalized that its culture and practices know no national boundaries, especially between the United States and Europe. Looking for a comparative perspective between the US and Norway, one finds more similarities than differences. A notable difference is the scale of the US science and technology enterprise compared to that of Norway. Another difference is the relative engagement with and importance of science and innovation policy research in Norway versus somewhat the opposite situation in the United States.

Fifth, the obstacles that lie between research and its use in other fields are also found in the area of science of science and innovation policy. This comes as no surprise. What makes it a bit more difficult is that, unlike areas such as health or energy research where science and technology are fully expected to contribute to decision making, research on science and technology itself benefits from no such general expectation. Decisions about science and technology are often left to scientists and engineers, or simply to the vagaries of the political process. Dissatisfaction with this arrangement is one factor helping to stir the growth of programs like SciSIP. However, sustaining the development of research focused on science and innovation will require that the needs of decision makers be met by SciSIP-type research. This raises the same sort of difficult questions that must be addressed by all disciplines seeking relevance: Who decides what information is needed? What is the role of researchers in questioning decision maker needs or priorities? How should conflicts of interest be handled? And so on. The SciSIP community has only just begun to ask these sorts of questions.

We expect to put together a special journal issue from the workshop. In the meantime, you can have a look at details of the event, including a number of very interesting background papers at: http://sciencepolicy.colorado.edu/rsd_for_rssip.

Understanding the Copenhagen Climate Deal: The Fix is In

Volume 23 | October 15, 2009

For those reading the tea leaves to understand the actions of various countries preparing for the international climate negotiations later this year in Copenhagen, the broad outlines of the ultimate deal are starting to come into view. The picture being revealed is not a pretty one for anyone actually interested in reducing future emissions to very low levels.

To understand the international climate debate, it is necessary to understand the underlying dynamics that shape the behavior of governments around the world. It is crucial to understand that many elected officials and governments now in power achieved their position, at least in part, through very ambitious promises to take aggressive action to reduce future emissions of carbon dioxide from burning fossil fuels.

For example, in the United Kingdom, both the governing Labor party and the (perhaps soon-to-be-governing) Conservatives strongly supported legislation that passed last December promising to reduce emissions to at least 34% below 1990 levels by 2022. Similarly grandiose promises on climate policy have been a mainstay of governments across Europe for over a decade. In Australia, the Labor government of Kevin Rudd made climate policy a defining position in the campaign that swept him into office in 2007; his stand culminated in a standing ovation from representatives of governments around the world when he appeared at the international climate negotiations in Bali that December, promising that Australia would lead on climate. In the coming months, the Australian legislature faces the prospect of a rare "double dissolution" forced election if the Senate refuses for a second time to approve Rudd's emissions-trading legislation that promises to cut emissions to as much as 25% below 1990 levels by 2020.

Japan's remarkable election brought the Democratic Party of Japan into power. Prime Minister Hatoyama has asserted that his government will dramatically strengthen the emissions-reduction targets of the previous government, to an incredible 25% reduction by 2020. And of course US President Barack Obama promised in his inauguration speech that his administration would mark the time when the "rise of the oceans began to slow," by making climate policy a top priority after years of neglect by the Bush Administration. The US legislation that passed the House of Representatives last June promised to reduce US emissions 17% from 2005 levels by 2020, and is now being considered in the Senate.

The problem with all these promises to achieve deep and rapid cuts in emissions is that no one knows how these cuts are going to happen, and most simply cannot happen as promised. So these countries have turned to designing very complex policies full of accounting tricks, political pork, and policy misdirection. Not surprisingly, these sorts of policies have run into considerable opposition among policy makers and the public, have been hijacked by political interests, and appear to fall well short of what has been promised. In Germany, Chancellor Angela Merkel has sought to weaken the effects of European climate policies on the German automobile industry; and in France, President Nicolas Sarkozy saw his proposal for a new carbon tax strongly criticized as unfair and regressive by his former (and perhaps future) presidential rival and Socialist Party figure, Ségolène Royal. Australian Prime Minister Rudd and US President Obama face the threat of outright revolt by conservative minority parties looking to secure political advantage by opposing proposed emissions-trading programs.

Even with all the policy complexity and political noise, it has not been difficult for anyone paying attention to realize that climate policies are in deep trouble. So what has been the primary response of governments? The tried-and-true strategy is to identify an enemy and focus attention on anything but the failing climate policies. In this case, the enemies identified by the rich, Western countries are India and China, with their huge populations, rapid economic growth, and increasing carbon footprints to match. Repeating a refrain heard in 1997 during negotiations that resulted in the largely ineffectual Kyoto Protocol, we again hear that without action from India and China, the climate policies of the developed countries will all be for naught.

In recent months, China and India have responded to this finger-pointing by presenting projections of their future emissions that show, rather incredibly, that both China and India have already transformed their economies to support rapid economic growth with very low carbon dioxide emission. Adopting binding emissions targets, they argue, will be unnecessary. Those hoping to see action in Copenhagen have welcomed these fantastic claims to argue that China, in particular, is becoming a leader in responding to climate change as a prod to the United States in particular. Chief UN climate negotiator Yvo de Boaer said of China's claims, "This suite of policies will take China to be the world leader on addressing climate change. It will be quite ironic to hear that tomorrow, expressed in a country (the United States) that is firmly convinced that China is doing nothing to address climate change." India's Environment Minister Jairam Ramesh recently commented with apparent envy and skepticism on China's public-relations success: "China has raced way ahead of us, both in terms of emissions and in conveying the impression they are doing a lot on climate change."

Following China's lead, India has sought to change the way it is perceived in the international debate. India now says that it has already transformed its economy to one that is rapidly decarbonizing - it promises upwards of 8% annual growth in its GDP with an emissions growth of only about 2% per year for the next two decades, without the need for any new policies including those focused on emissions reductions. China has taken a very similar approach. China's carbon dioxide emissions increased by 12.2% per year from 2000 to 2007 but it now says that, based on its policies in place today, it expects its greenhouse gas emissions to increase only 2.5% per year until 2030, while maintaining a GDP growth of 9% per year. These numbers imply decarbonization of the Indian and Chinese economies at a rate of about 6% per year, which is far-fetched even under scenarios with aggressive new policies (which are not these scenarios), and preposterous under scenarios of business as usual. The fastest decarbonization rate of any large economy I know of occurred in the early 1980s, when Japan's economy achieved a decarbonization rate of about 4.4% per year due to aggressive energy efficiency policies as well as major changes in the Japanese economy. Even then, the rapid decarbonization of the Japanese economy slowed considerably by the mid-1980s, and has averaged about 1% per year since then.

India's Ramesh is so confident in the hand that his government has played that he has dared the developed countries to "call India's bluff." He knows full well that the developed countries cannot acknowledge the fictional nature of the Indian and Chinese emissions policies, because it would be only a short step from making such a claim to a broader recognition that climate policies of the developed world are built on similar foundations of sand. Ramesh is so confident that he has already declared the troubled bill now in the US Senate to be insufficient, even if it is somehow passed into law. "The bill . . . talks about a 20% cut on 2005 levels, which is really only a measly 5% reduction on 1990 levels." Such tough talk seems to make developed countries step back. Consider David Miliband, minister for Climate Change in the UK, who asserted that the Indian proposals might just get them off the hook of signing binding commitments at Copenhagen, because they have now demonstrated that they "took climate change seriously." Don't expect any governments in other developed countries to call Minister Ramesh's bluff either.

So where does this leave international climate policy? The good news for international negotiators and politicians who have promised action is that the stage is set for a global agreement of some sort but, we are told, perhaps not with I's dotted and t's crossed. This means that government claims to be taking action can be backed up with evidence of some sort of an agreement at Copenhagen, while at the same time ineffectual domestic actions can be sustained. If the negotiators are really clever, they will find a way to package the ineffectual domestic policies as a sort of patched-together global agreement.

However, for those who care about emissions reductions, especially leading environmental groups and activists in the science community, the joke will be on them - they will get just about everything they campaigned for, except any prospect for actual reductions in future emissions. Meanwhile, India and China will be able to continue their current round of securing oil, gas, and coal from sources around the world to fuel their booming economic growth. Similarly, as we march toward Copenhagen, the Obama Administration has quietly set forth plans to build a pipeline from Canada to exploit carbon-intensive oil locked in tar sands. The United Kingdom and other EU countries are considering building new coal and gas plants to meet growing needs for power. As long as leaders of the climate movement continue to pretend that progress is being made, the climate policy charade will go on for a while longer, while business proceeds as usual.

Building Bridges between Europe and North America in Science Policy

Volume 24 | December 21, 2009

Every two years since 2000 the Gordon Research Conferences (GRC) has held a research conference on Science and Technology Policy. The meeting has evolved to become a leading forum for a diverse set of academics and others interested in science and technology policy (or STP) to come together to discuss research in STP as well as the role of research in STP decision making. The meeting involves leading scholars and practitioners and has itself become an interdisciplinary node for the sprawling and ill-defined area of scholarship at the complex interface of science, technology and decision making.

One opportunity that has yet to be fully capitalized on in this meeting is to bring together European-based STP scholars with their counterparts in North America, as the meeting has historically been U.S. focused with mostly U.S. participants.

Since I am the chair of the 2010 conference, the opportunity to use the build partnerships is one that I'd like to more fully exploit. My partners in this effort include my co-chair, Michele Garfinkel a policy analyst at the J. Craig Venter Institute, and the 2012 chair Susan Cozzens, professor of public policy at Georgia Tech University. Together we are putting together a meeting focused on building partnerships in science and technology policy research while focusing on stimulating discussions at the frontiers of STP research.

Over the past decade I have had the opportunity to spend a lot of time collaborating with colleagues in Europe on a range of science policy topics and one thing that I have noticed is that, with a few notable exceptions, the connections between STP scholars across the Atlantic are not as well developed as they could be. One of the notable examples of where excellent partnerships exist is in the area of science and technology studies (STS), where the European Association for the Study of Science and Technology (EASST) has well developed collaborations with the U.S.-based Society for the Social Studies of Science (4S). Other notable examples of strong collaborations can be found in the Science and Democracy Network pioneered by Harvard's Sheila Jasanoff and of course the work of the 2012 GRC chair Susan Cozzens.

In 2010 the meeting will be held August 8-13 in Waterville Valley Resort, in New Hampshire, which is about 90 minutes north of Boston. The meeting format is dictated by GRC, and has sessions in the morning before lunch, afternoons off for informal meetings and discussions, and then sessions in the evening following dinner. We have prepared a very preliminary agenda for the meeting, in which we speculated on ideal participants who have yet to be formally invited, much less confirmed. Here is that agenda to give a sense of the topics and desired participants:

- The Big Issues in Science and Technology Policy Research (Daniel Sarewitz / Peter Weingart / Susan Cozzens)

- STS and STP: Is There a Community or are There Communities? (David Guston / Silke Beck / Mark Brown / Shobita Parthasarathy / Elizabeth McNie)
- Science Policy Research and Science Policy Decisions Case Study: US Genetic Information Non-Discrimination Act (Joan Scott / Cindy Pellegrini / Muin Khoury / Joann Boughman)
- Comparative Perspectives on Science Technology Policy Research in US and EU (Steve Rayner / Jack Stilgoe / Merle Jacob / Barry Bozeman)
- Case Study: Chemical Regulation in US and EU (Phil Macnaghten, Greg Nemet / Astrid Schomaker / Steve Owens / Richard Denison)
- Science and Technology Policy Education: How are We Doing? (Kevin Finneran / Chuck Weiss / Magnus Gulbrandsen / Bill Hooke)
- Politicization of Science: How Much of a Problem? (Donald Kennedy / Philip Campbell / Neal Lane)
- Science and Democracy: What Role for Science Policy Research? (Eva Lövbrand / Per Koch / Nico Stehr / Daniel Lee Kleinmann)
- The Future of Science and Technology Policy Research (Susan Cozzens / Rachel Ankeny / Tom Kalil)

The topics at the meeting are split between case studies and discussions of the field (such as it is). Discussions focused on the field will include a close look at where it has been, where it might be going, education and comparative perspectives. The topical sessions will also include comparative perspectives on chemical regulation, genetic screening and the politicization of science. We expect to include a number of practitioners at the meeting, both in the program and as participants. All sessions are "off the record" to encourage open discussion of the latest research and its potential significance.

We are hopeful to attract a much larger European presence at the meeting than has been the case previously. The event has a great track record of including early career professionals and students. There is a significant poster session during the week focused on presented the work of early career scholars. To these ends we are still very much involved in fund raising for the meeting, and would welcome any advice or, especially, contributions. We are trying to fund the meeting based on relatively small levels of support from a wide range of contributors.

Details on the 2010 GRC Conference on Science and Technology Policy, including information on how to register, can be found online at: http://www.grc.org/conferences.aspx?id=0000458. The meeting is capacity constrained at about 120 people, so be sure to register soon. If you have any questions about the meeting (or if you'd like to help support it!) please contact me at pielke@colorado.edu.

Meantime, happy holidays and wishing you a happy 2010!

Inside the Black Box of Science Advisory Committee Empanelment

Volume 25 | April 21, 2010

In my graduate seminar on science and technology policy, I have developed a unit focused on the empanelment of scientific advisory committees. The empanelment process - that is, the selection and appointment of committee members to advise policy makers - is a largely unstudied aspect of science policy, but one with significant importance for understanding the role of expertise in decision making and the intersection of science and politics.

In the United States, science advice has flourished in government. In 1950 approximately 350 scientists advised the federal government, but by 2003 approximately 8,000 scientists served on about 400 federal advisory committees. In addition, more than 6,000 scientists advise the government through committees of the National Research Council, established in 1918 to expand government access to scientific expertise.

Who chooses these advisors? And through what process?

Answers to these questions are not easy to come by, because the empanelment process has long been out of sight, even for close observers of science policies. However, the obscurity of empanelment decision making changed dramatically during the administration of George W. Bush when administration officials asked prospective advisory committee members about their politics, including whom they had voted for in the previous election. It was hard to avoid the impression that the Bush Administration was trying to "stack" its advisory committees with experts who held friendly ideological or political perspectives.

The Bush administration's efforts led to more attention being paid to the empanelment process, especially by its political opposition. This trend has continued. For instance, after the University of East Anglia appointed an independent committee to review issues associated with the release of emails from climate scientists, a member of that committee (Phil Campbell, editor of *Nature*) was forced to resign when critics of the review discovered earlier comments he had made on Chinese State radio in support of the East Anglian researchers at the focus of the inquiry, and then called into question his objectivity. Similarly, in recent weeks and months the UK has seen a number of high-profile resignations from a drug advisory committee over alleged politicization of their advice and the government's handling of the committee. For better or worse, the empanelment process is now a political battlefield.

To give my students a sense of what happens in the empanelment process, I ask them to serve as empanelers in a class project to create a hypothetical science advisory committee in the area of climate science. The subject area for the unit really does not matter, so long as there is readily available information on prospective panelists. In other years I have used endangered species as a focus.

The rules of the assignment are:

- the students can pick anyone in the world;
- the committee to be empaneled must be a “science arbitration” panel as described in my book, *The Honest Broker*. A science arbitration panel focuses on questions that can be addressed empirically, including consideration of associated areas of uncertainty and ignorance, using the methodologies of science;
- the focal area for this assignment is “physical climate science,” as represented by Working Group I of the Intergovernmental Panel on Climate Change;
- the committee may have no more than 12 members.

I divide the class into three groups, and each is to present a proposed committee and write an accompanying press release. The students in my course this term come from a range of disciplines - chemistry, geology, atmospheric science, sociology, anthropology, environmental studies, policy, and journalism - and are highly qualified for their role as empanelers. In fact, if history is a guide to the future, then some of these students will be helping to empanel expert committees in just a few years.

The purpose of the hypothetical committee that they are empanelling is to stand ready to respond to questions posed by policy makers, nationally and internationally, about physical climate science. Consistent with the notion of “science arbitration,” questions about “what to do” are not part of the purview of the committee. As a lead-up to the assignment, we discussed guidelines for empanelling such a committee, as recommended to the Obama Administration by the Bipartisan Policy Center in a report produced in 2009. However, the class groups were free to choose whomever they wanted and to justify those selections however they’d like.

Midway through the assignment, I asked the students to present their prospective list of committee members for discussion in the class. This year the three groups presented a total of 67 potential committee members across the three groups and, rather remarkably, no scientist appeared on more than one group’s list.

The three groups began by taking very different approaches to the exercise. One group began by trying to assemble a committee that would “motivate action on climate policy” even though advocacy was outside the mandate of the committee. They selected people for their political orientation and perceived credibility with key stakeholder groups more than for their expertise. Group two chose a different path, relying mainly on scientists with a career track record of serving on such committees, but also including a few new faces. This group also had politics in mind, but was much more subtle. For instance, they decided to avoid scientists who expressed skepticism regarding the overarching consensus on climate science as put forth by the IPCC. Group 3 took yet another route to empanelment and focused on creating a “balanced” committee with skeptical scientists and those who endorsed the IPCC consensus.

The proposed committees enabled a rich and interesting discussion. We asked ourselves questions such as: What sort of scientific judgments should the empanelers make? Should outlier views be included, or not? How should balance among gender, race, or nationality be addressed? Is balance of any sort desirable? Is it possible to ignore panelists’ political and policy preferences? Is it desirable to ignore those preferences? The ways such questions are answered will lead to vastly different committees with different memberships.

The process of eliciting expert advice through scientific advisory committees has a long and distinguished history. However, as science becomes more politicized, a better understanding of the empanelment process and the resulting legitimacy of advice will become ever more important in effectively marshalling expertise in service of decision making.

You can see the results of my students’ work this term here:
http://rogerpielkejr.blogspot.com/2010/04/climate-science-advisory-dream-teams.html

Sport: An Academic's Perfect Laboratory

Volume 26 | July 14, 2010

Big sporting events tend to bring out the armchair social scientists. For instance, when Europe advanced only three teams to the quarterfinals of this year's World Cup it was hailed by some as an indication of the decline Europe's geopolitical standing role, to the benefit of South America. That theory lasted only about as long as it took for Argentina and Brazil to fly home after losing to rivals from Old Europe. Similarly, Gideon Rachmon of the Financial Times points to the columnist in Spain's El País who suggested that "England's loss to Germany over the weekend reflects Thatcherism's demoralising effects on the English proletariat. (And there was I, thinking that it had something to do with lumbering centre-backs and a disallowed goal.)"

As much fun as it is to poke fun at sports-infused pseudo-social science, there is actually much of value to be gleaned from sports for understanding human behavior and important societal questions. For instance, in 2009 two scholars at the Wharton School of Business released a creative study of decision making among professional golfers to assess bias in decision making. The study utilized a data set of more than 2.5 million putts from 421 golfers over a period of five years. In the study the scholars wanted to see if there was any difference in putts made for par (what a golfer is supposed to score on a hole) versus birdie (one stoke less than par). The study found that for putts of equal length, professional golfers made putts for birdie at a rate less than for par. What is the reason for this difference? Golfers played more conservatively when putting for birdie knowing that a miss would lead to a par, whereas a missed putt for par left them with an unsavory bogey. The paper provided a robust confirmation of the notion of "loss aversion" in decision making. Like the rest of us, professional golfers would rather avoid a negative outcome than achieve a positive outcome with exactly the same quantitative value.

Golf, like many sports, provides an ideal setting for exploring understandings of human behavior and decision making: You have highly skilled and experienced decision making that occurs in a controlled setting, governed by known rules, and with an enormous amount of data available. Academics are rarely able to create such settings via research grants. Sport provides a ready-made laboratory for exploring a wide range of social and policy sciences questions.

Sport supplies an opportunity for exploring more qualitative questions as well. Consider the case of South African sprinter Oscar Pistorious who runs remarkably fast, perhaps too fast, on prosthetic legs. Should he be allowed to compete in the Olympics against other athletes? How is such a decision to be made? His circumstances raise important questions of fairness, equity, opportunity and, fundamentally, of the human condition.

Such questions often are found at the intersection of technology and society. In the Tour de France bicycle race, a distinction between trying to gain advantage through blood doping, which is very much against the rules, versus sleeping in a portable hyperbaric chamber, which is allowed, is a useful analogy for thinking about the differences between, for instance, manipulation of genetic make-up of crops through selective breeding versus advanced biotechnology. The use of technologies in sport is governed by many of the same cultural, political, and technical considerations that govern the acceptance of technologies in society more broadly.

Sport also affords a lens into political issues. Consider the debate that followed Luis Suarez of the Uruguayan football team, who in this summer's World Cup famously handled the ball as time expired, preventing a goal for Ghana and eventually setting in motion a series of events that would lead to Uruguay winning the match. Some were outraged at the action, complaining that the action was cheating. Others saw the action as a trade-off between violating the rules and accepting the sanction that followed, no different from an illegal slide tackle or, in American football, taking a pass interference penalty to prevent a touchdown. The situation provides an opportunity to analyze rules and norms governing societal behavior more broadly. Can every contingency be accounted for in rules? If formal sanctions are deemed unsatisfactory, are informal sanctions associated with violation of informal norms a substitute for rules?

Perhaps even more than the broader society, sport has seen the advancement of technology as something to be carefully regulated, with technological advance not necessarily seen as a good thing. Baseball uses wooden bats, when far more powerful metal bats are available. Similarly, the international swimming federation has banned high-performance swimming suits. Professional golf has banned clubs with certain grooves, and Formula One racing has very strict technological standards for its cars. Not all technological advances, simply by virtue of being advances, are welcomed in sport. In fact, it seems that the general bias in sports is to eschew most technological advances, even when they might make good sense - such as putting a chip in a soccer ball to identify when it crosses the goal line.

Sports provide a valuable context for evaluating expertise, and not just among athletes but among those who purport to understand the dynamics of sporting events. For instance, ESPN, the US-based sports media enterprise, hosted a competition for predictions of the outcomes of the 2010 World Cup. Of the more than 1,000,000 entries submitted, only 10 percent would have improved on naïve predictions based on the transfer market-value of each team, i.e., assuming that the higher valued team would win each game. In fact, the "expert" predictions offered by the financial services firms Goldman Sachs, JP Morgan, and UBS fell only at the 61st, 67th, and 35th percentiles in the ESPN competition, respectively, all behind a naïve forecast based on FIFA World Rankings, which scored at the 70th percentile. What might this say about these firms' ability to predict market outcomes?

Sports offer a vast laboratory for exploring challenging questions in the quantitative and qualitative social sciences. Such questions have wider relevance for decision making in society, well beyond sport. In future years, expect more social scientists to turn their attention to the study of sports, and to draw lessons with much broader applications.

Success is not Guaranteed

Volume 27 | October 19, 2010

This month marks the release of my latest book. Titled The Climate Fix: What Scientists and Politicians Won't Tell You About Global Warming (Basic Books, NY)[1], one of the core arguments in the book is that efforts to secure international agreement on targets and timetables for emissions reductions are doomed to failure.

In the book, I argue that if we are going to make progress in accelerating the decarbonization *of the* global economy *then, rather than futile efforts to establish a grand global agreement on targets and timetables, it is far more important to emphasize a more direct approach to innovation in* energy technologies *with a focus on expanding energy access and lowering costs. To finance these investments, I propose a low but rising price on* carbon *(or* fossil fuels*) that is set at the highest level politically possible (which is necessarily low). Instead of seeking to make carbon-intensive energy supplies appreciably more expensive, policy should focus on bringing down the cost of alternatives. Hence my focus is on policies that will accelerate innovation in energy technologies.*

I am optimistic that taxing today's energy sources to pay for tomorrow's will be politically appealing because it is already being implemented in settings as diverse as India and Germany. India has set a 50 rp tax per tonne of coal in order to raise more than $500 million per year to invest in clean energy innovation*. This tax is equivalent to about a $0.30 per tonne carbon tax - high enough to raise significant funds but not to create public opposition. Similarly, Germany is planning to extend the life of its nuclear power stations and to use the resulting financial windfall - partly due to a tax on fuel rods - to generate almost $40 billion, freeing up significant resources to invest in* energy innovation*.*

One can imagine how such a direct approach in innovation might be implemented in other countries or even be the subject of international collaboration. Consider that a $5 per tonne carbon tax would raise about $100 billion per year, as would a $3 per barrel fee applied to petroleum, with largely imperceptible effects on energy prices. Such small taxes raise large amounts with small consumer impact because the direct cost of energy is about 5-10 percent of the global economy, an enormous sum.

These sort of "technology-led" proposals funded by a low-but-rising tax are spelled out in far greater detail in my book, in "The Hartwell Paper"[2] (a collaboration led by the London School of Economics and Oxford University that I participated in earlier this year) and, in particular, in the work of economists Isabela Galiana and Chris Green at McGill University.

These ideas are often the subject of discussion and debate on my blog, providing a useful opportunity for critique. In such discussions I have found an interesting objection to the proposals, which comes both from those who favor the conventional, top-down targets and timetables approach as well as from those who are opposed to efforts to intentionally seek to accelerate the decarbonization of the economy.

Both arguments are grounded in a desire for certainty in policy proposals. One line of critique expresses frustration that the technology-led approach cannot offer certainty in the timing of achieving specific atmospheric concentration targets. For example, one commenter on my blog writes of "The Hartwell Paper" that it "provide[s] no indication of the impact of the proposed policies in terms of reducing emissions and hence of where we would expect to end up in terms of atmospheric concentrations. Without this, it is impossible to tell the extent to which the policy you are advocating would be successful in terms of avoiding damaging impacts from climate change."

Such arguments are akin to criticizing investments in health research because those advocating such a policy cannot provide an indication of the impact of such investments on outcomes such as extending future life expectancies. Of course, we invest in health research not because of certainties regarding those investments and future death rates, but because we know that innovation in medicine is made more likely by focusing resources in that area. Experience indicates that technological innovation can be shaped and directed, but there are no guarantees of specific outcomes on specific timetables. Such certainties can be found in economic models, but not in the real world.

A similar demand for certainty in outcomes comes from another perspective, and focuses on the implications of a low carbon or fuel tax, proposed to raise funds for investment in energy innovation: "What evidence do you have that the governments won't spend the money generated by the small tax on things that won't reduce carbon emissions at all?"

If progress is going to be made in energy technology innovation that leads to an accelerated decarbonization of the global economy, then effort will be needed over many decades. Yet politicians today cannot bind their successors, much less policy analysts, to certain actions. For any proposed policy to be politically sustainable, it must show benefits that are perceived by the public to be proportional to its costs, and on similar time scales. Conventional approaches to climate policy promise benefits decades in the future for costs today, one of its Achilles' heels. Long-term public support of investments in agriculture, infrastructure, medicine, and other areas, supported by tax revenues (in some cases directly linked) provides evidence that sustained public investment over many decades is possible in technological innovation. But again, there are no guarantees.

More generally, such arguments raise interesting questions about the purpose of and limits to policy analyses. Consider that politicians who control the machinery of governments are unable to offer guarantees for particular outcomes, even in the very short term. For instance, before the recent Australian election, Prime Minister Julia Gillard promised her electorate that a carbon tax was off the table, but now it appears to be her favored policy option. Similarly, Barack Obama promised to end the "don't ask, don't tell" policy in the US military and did not. One need not look far to find plenty of such examples.

Not even the existence of legislation offers guaranteed outcomes. The Kyoto Protocol promised to reduce emissions in Europe, yet decarbonization rates in Europe are essentially unchanged from before Kyoto to after its implementation. Its Clean Development mechanism may even have contributed to accelerated emissions. In Great Britain, its climate change act promises to reduce UK emissions by 34 percent by 2020. Anyone who expects that to happen is in for a surprise.

Policy analysis is not about offering guarantees, but when done well it offers options that link alternative possible courses of actions with desired outcomes. The best that a policy analyst can do is to argue that taking one fork in the road is more apt to get the decision maker to a desired destination than taking a different fork in the road. Such arguments will either be convincing or will not. In democratic systems of governance the road to any destination is always treacherous, with new destinations, forks in the road, and obstacles to progress arising all the time. Consider that Germany's recent decision on nuclear power reverses an earlier decision to phase it out. And its current approach may yet change due to political opposition.

While I cannot guarantee that the policies I recommend in my book will succeed, I do think that they offer the best way forward to simultaneously meet the policy goals of expanding energy access, securing long-term supply at affordable costs, and accelerating the decarbonization of the global economy. The policy analysis in the book makes this case. At the same time, I am convinced that the conventional approach to climate policy will continue in its failure to show progress on these fronts. That's one guarantee I am willing to make.

References

1. http://www.perseusacademic.com/book/paperback/the-climate-fix/9780465025190

2. http://www.lse.ac.uk/collections/mackinderProgramme/theHartwellPaper/

Beyond the Annual Climate Confab

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Woody Allen once famously said that 80 percent of life is just showing up. A similar calculus might be applied to the global climate negotiations, the annual confab that brings together activists, politicians, and other interested parties to discuss how the world might deal with the threat of climate change.

The outcome at this year's conference in Cancun was similar to each of the previous 15 conferences - an agreement of some sort was reached, which some applauded and others criticized. Either way, we have been told that the real global agreement lies just one year in the future. This year's "next year" is in Durban, South Africa. Yet a close look at what happened at Cancun, even more than the fractious Copenhagen conference the year before, provides the best evidence yet as to why a binding global agreement to reduce emissions remains a year away, and always will.

International climate negotiations have become cluttered with many issues and agendas, but at their core is the 1992 Framework Convention on Climate Change, which is focused on stabilizing concentrations of carbon dioxide and other greenhouse gases resulting from human activity, mainly the burning of fossil fuels.

In 1997 the Kyoto Protocol was negotiated under the Climate Convention, and it has served as the touchstone for all negotiations since. It also set the terms for the present stalemate, one that could only be broken by scrapping the Kyoto Protocol and revisiting the Climate Convention itself, neither of which seems likely to occur anytime soon.

To understand why this is the case, one must understand the international political dynamics created by the Kyoto Protocol. A central feature of Kyoto was to divide the world's countries into two categories, often characterized by the misleading labels of "developed" and "developing." The former countries were expected to commit to binding pledges to reduce emissions by a certain amount by 2012, and the latter were freed from any such responsibilities.

In the years that followed its introduction in 1997, countries of the first type dutifully ratified the Kyoto Protocol, with one notable exception: the United States. In 2001, George W. Bush poured salt into the open wound caused by US nonparticipation. But the decision had been reached several years before Bush was elected, when the US Senate voted unanimously that it would reject the treaty were it brought before them.

Europe was once Kyoto's greatest champion, implementing a wide range of policies focused on emissions reductions, most notably its Emissions Trading Scheme and Clean Development Mechanism. But it has become apparent that such policies, while arguably achieving many things, did virtually nothing to accelerate the pre-existing rate of decarbonization of the European economy. In the meantime, the expansion of renewable technologies has been fraught with challenges, security of supply has taken on greater importance in several countries (particularly those dependent on gas from the east), parts of Europe have in fact been recarbonizing in recent years, fault lines have developed between east and west on EU energy and climate policies, and financial crises have limited enthusiasm for higher-priced energy. These and other factors have meant that the justifications for Kyoto in Europe changed from a focus on actual emissions reductions to seeing the Protocol as a necessary first step toward a much broader global agreement that would, in fact, be effective in ways that Kyoto is not.

Europe's dampened enthusiasm for a go-it-alone approach to Kyoto was clearly reflected in its pre-Cancun decisions to defer a debate on increasing its 2020 emissions reduction commitment from 20 percent to 30 percent (reflecting total emissions equal to two weeks of China's 2010 emissions - itself an indication of Europe's diminished role), and to adopt a stance that any follow-on to Kyoto should require that the countries with no binding commitments in the 1997 agreement take on such commitments in a Kyoto 2.

At the same time that Europe was preparing its pre-Cancun negotiating position, the so-called BASIC countries (Brazil, South Africa, India, and China) and their allies were preparing their own unified stance, which called for a commitment to extending Kyoto but resistance to any overture that they take on binding emissions reductions targets.

The differing positions of Europe and the BASIC countries alone would have been enough to lead to a stalemate in Cancun, but it was Japan that made the obvious inescapable. Japan proclaimed, at the start of the Cancun meeting, that it was in no way prepared to sign on to any agreement for a follow-on to Kyoto that did not have the participation of the United States and the so-called developing countries. Japan's unexpected hard line caught many by surprise and attracted much scorn toward Japan among activists and other supporters of the Climate Convention.

The reason for Japan's stance is not difficult to fathom. Following the historic election of August, 2009, the new government, in what was undoubtedly a moment of populist exuberance, promised to increase Japan's emissions reduction commitment from a 15 percent reduction by 2020 (from 2005 levels) to 37 percent. Such a reduction, which would likely turn into Japan's international commitment under a Kyoto 2, is simply not practically achievable. Professor Tetsuo Yuhara of the University of Tokyo estimated that among the actions required to meet the target would be 600,000 new solar installations each year, 15 new nuclear power plants, electric vehicles comprising 90 percent of all new purchases, and a carbon price of $80 per tonne (1tonne = 1.1 tons, US). With one of the most carbon-efficient major economies on the planet, an emissions reduction of 37 percent by 2020 are not remotely possible in Japan, under even very modest economic growth.

So, rather than participating in a continued charade, Japan simply said that the Kyoto emperor has no clothes. At Cancun, Russia and Canada soon followed in Japan's footsteps, and eschewed participation in a second Kyoto commitment period. When India's environment minister went a bit rogue in the other direction by suggesting that India would be open to binding emissions reduction commitments, he was quickly brought back in line by his prime minister, who explained that India was not about to make any such commitments. In short, the fault lines created by Kyoto are as deep and unbridgeable as ever, and all but certain to persist indefinitely.

Japan's brave refusal to play along in the emissions reduction charade reflects a broader truth - targets and timetables for emissions reductions do not in fact reduce emissions; technology reduces emissions. Furthermore, targets and timetables for emissions reductions do not make technologies magically appear. Incentives and investments in innovation are what lead to technological advances. Any hopes that political promises in a grand international treaty focused on targets and timetables would stimulate such advances by compelling domestic political actions around the world have been repeatedly dashed.

It is telling that the most important decision reached at Cancun was that the international process of negotiating should continue, with hopes that Durban, 2011, will be where countries around the world once and for all seal the deal.

The more likely outcome is that in 2011 the international negotiations will see the US, Canada, Russia, Japan, and even the EU continue to maintain that developing countries will have to take on binding commitments to emissions reductions, and the BASIC countries will stand firm in their position that such binding commitments are simply not going to happen. The 2011 climate confab will end either in recrimination, like Copenhagen, or in a largely meaningless agreement, like Cancun, with a promise that 2012 is when the action will really take place.

The most significant actions that will lead to accelerated decarbonization of the global economy will necessarily take place outside of the international negotiating process under the Climate Convention. At this point, the challenge of reforming the Climate Convention may be a larger task than actually reducing emissions. Fortunately, enough leadership is being shown, with the Japanese government a prominent example, that one can indeed have some optimism that effective action can take place. But full recognition that the locus of action lies outside the UN process is likely to take still more time to be fully appreciated.

Democracy's Open Secret

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Last month in an op-ed[1] in The New York Times, I poked a little fun at Michele Bachmann, a member of the US Congress from Minnesota and a potential Tea Party candidate for President. The occasion for my commentary was Ms. Bachmann's remark that the government should have no role in influencing consumer decisions on light bulbs.

My rejoinder pointed out that the government has been setting performance and other standards for technologies for over a century, and that such standards have been instrumental in stimulating innovation and economic growth. Ms. Bachmann's comment was as poorly informed as those US citizens who demand that the government keep its hands off of their Medicare (a government-run health-care program).

It would be easy to attribute Bachmann's apparent lack of understanding of the government's role in science, technology, and innovation to the anti-government zeal espoused by the Tea Party. Surely the idiosyncrasies of the Tea Party help to explain its blind spots when it comes to observing the positive roles that government can play. However, there is a deeper issue here that spans political parties across nations: a lack of recognition among policy makers of their dependence on experts in making wise decisions. Experts do not, of course, determine how policy decisions ought to be made but they do add considerable value to wise decision making.

The deeper issue at work here is an open secret in the practice of democracy, and that is the fact that our elected leaders are chosen from among us, the people. As such, politicians tend to reflect the views of the general public on many subjects - not just those subjects governed solely by political passions, but also those that are traditionally the province of experts. Elected officials are not just a lot like us, they are us.

For example, perhaps foreshadowing contemporary US politics, in 1996 a freshman member of the US Congress proposed eliminating the US government's National Weather Service , declaring that the agency was not needed because "I get my weather from The Weather Channel." Of course the weather informaton found on The Weather Channel comes from a sophisticated scientific and technological infrastructure built by the federal government over many decades which supports a wide range of economic activity, from agriculture to airlines, as well as from the private sector weather services.

European politicians have their own blind spots at the interface of science and policy. For instance, several years ago former German environment minister Sigmar Gabriel claimed rather implausibly that: "You can build 100 coal-fired power plants and don't have to have higher CO_2 emissions." His explanation was that Germany participates in emissions trading and this would necessarily limit carbon dioxide no matter how much was produced. Obviously, emissions trading cannot make the impossible possible.

Many people can recall the disturbing spectacle, as the BSE scare was unfolding in 1990, of UK Agriculture Minister John Gummer feeding his daughter a hamburger in an effort to demonstrate to the public the safety of beef. Not only did Gummer's actions circumvent expert advisory processes, they undercut them.

We should expect policy makers to face difficulties when it comes to governance when it involves considerations of science, technology, and innovation for the simple reason that they are just like everyone else -- mostly ignorant about mostly everything. For instance, in 2010, the US NSF reported that 28% of Americans and 34% of Europeans believed that the sun goes around the earth. Similarly, 30% of Americans and 41% of Europeans believe that radioactivity results only from human activities. It should not be so surprising when we learn that policy makers may share such perspectives.

A popular view is that more education about science and technology will lead to better decisions. While education is, of course, important to a healthy democracy, it will never result in a populace (or their representatives) with expertise in everything.

Consider that the issues at the top of public debate today as I write this column include nuclear safety, unrest in numerous Arab countries, increasing food costs, a debt crisis in Portugal, and so on. One could imagine dozens and dozens of policy-relevant PhD dissertations related to each subject. Achieving such heroic levels of expertise is not realistic for anyone. Instead, we must rely on specialized experts to inform decision making. Just as you and I often need to consult with experts when dealing with our health, home repairs, finances, and other tasks, so too do policy makers need to tap into expertise in order to make good decisions.

So it should be far less worrisome that the public or policy makers do not understand this or that information that experts may know well. What should be of more concern is that policy makers appear to lack an understanding of how they can tap into expertise to inform decision making. This situation is akin to flying blind.

Specialized expertise typically does not compel particular decisions, but it does help to make decisions more informed. This distinction lies behind Winston Churchill's oft-cited advice that science should be "on tap, but not on top." Effective governance does not depend upon philosopher kings in governments or in the populace, but rather on the use of effective mechanisms for bringing expertise into the political process.

It is the responsibility - even the special expertise - of policy makers to know how to use the instruments of government to bring experts into the process of governance. The troubling aspect of the statements and actions by the Gummers, Gabriels, and Bachmanns of the political world lies not in their lack of knowledge about science, but in their lack of knowledge about government.

References

1. http://www.nytimes.com/2011/03/11/opinion/11pielke.html

The Policy Advisor's Dilemma

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More than 65 years ago the sociologist Robert K. Merton described a key challenge faced by policy analysts: An analyst must achieve a balance between being close to decision makers to ensure that the advice is deemed relevant and useful while, at the same time, maintaining a degree of independence in order to exercise judgments based on the merits of the issue rather than political expedience. Merton explained that while relevance required the analyst to become "part of a bureaucratic power structure," such participation may lead the analyst "to abdicate his privilege of exploring policy possibilities which he regards as significant."

Yet, an analyst seeking to maintain independence "in order to provide full opportunity of choice" will typically find that "he has neither the resources to carry through his investigations on an appropriate scale nor any strong likelihood of having his findings accepted by policy makers as a basis for action." An analyst cannot resolve this dilemma alone, as policy makers must create (or at least tolerate) policy advisory mechanisms that provide independent judgments, even when these are uncomfortable or challenging.

Consider the recent case of one major climate adaptation and mitigation research project in Europe, as described in a forthcoming paper[1] in Science and Public Policy by Eva Lövbrand of Linköping University (disclaimer, Eva is a collaborator and her project was supported by a grant on which I was PI). The ADAM project[2] (short for "Adaptation and Mitigation Strategies: Supporting European Climate Policy") was an €18 million research project funded by the EU from 2006 to 2009 with an objective, as its title suggests, of conducting research in support of European climate policy.

Lövbrand documents several efforts by ADAM to perform policy-relevant research, and carefully emphasizes that her work examines only a small set of experiences in the rich and varied implementation of the ADAM project. Her analysis documents several instances of tensions arising from the very close connection between ADAM and EU climate-policy makers.

For instance, when ADAM organized its first stakeholder workshop in January, 2008, it found little interest in the project among the decision makers whom it had targeted. One reason for this, Lövbrand suggests, is the fact that two days before the workshop DG Environment had released its "Climate action and renewable energy package,"[3] intended to guide European attainment of its 20 percent emissions-reduction target by 2020. Having already committed to a policy proposal, the policy makers had little desire to see the project's varied policy analyses. Instead, they needed information that would be useful in advocating the course of action to which they had already made a commitment. As Lövbrand writes: "To open up the policy debate to new ideas may not appear particularly useful to policy practitioners who are in the process of closing it."

Lövbrand provides a second example from the ADAM experience, one that highlights the project's responsiveness to the expressed needs of decision makers. As climate negotiations proceeded, Lövbrand explains that EC officials had asked ADAM's leader to reorient their research agenda to reflect the increasing political importance of low stabilization targets. Lövbrand explains that the officials "hoped that the ADAM research might lend support to the lowest of the [emissions scenarios] considered by the IPCC" (Intergovernmental Panel of Climate Change). ADAM was responsive to the policy makers' requests, meaning that: "In order to be useful for the EC in the ongoing UN negotiations on climate change, the ADAM researchers were asked to give scientific support to, rather than to challenge, the policy goals formulated by the EU."

There are several different and perhaps even incompatible ways of evaluating the experiences of the ADAM project's interactions with decision makers, as recounted by Lövbrand. From one perspective, the project was a model of effective interaction between researchers and decision makers, as the research community was willing to adapt its work to supply information being requested by decision makers. In the jargon of the academic community, this experience represents a healthy "coproduction" of knowledge. ADAM successfully provided "useful" research.

But in another sense the ADAM experience is troubling. Its top-line conclusions about the feasibility of meeting a 2 degree C temperature target, while accepted in the European political discourse, were far from universally accepted; indeed, from today's vantage point they look to have been overly optimistic. In my own judgment, the achievement of such targets and their utility in policy is highly questionable (for details, see my book *The Climate Fix*[4], Basic Books, 2010). From this perspective, while ADAM delivered the research results that EU decision makers *may have wanted* in the politics of the moment, it was far from the information that these decision *makers may actually have needed* to achieve the ultimate climate-policy goals.

Contrast the ADAM experience with the intelligence on weapons of mass destruction provided to the administration to George W. Bush. When the US CIA provided information that was equivocal and uncertain about the presence of WMDs, the Bush administration rejected the advice and instead established a separate mechanism of intelligence analysis within the White House. Unsurprisingly, the new, much less independent organization helpfully provided information that was more conducive to the desired decision. Such knowledge was "coproduced" as well.

What is the difference between the case of WMDs, where policy analysis was provided in response to the stated needs of decision makers, and the case of ADAM in which policy analysis was similarly provided in response to the stated needs of decision makers?

Some might assert that the difference lies in the quality of the information provided. There were no WMDs in Iraq, while one could always maintain the plausibility of achieving a 2 degree target, based on an alternative analysis of the facts. But for purposes of discussion, let's simply assume that a 2 degree target is, in fact, unachievable. In such a case, what then would be the difference between the two examples?

It would be tempting to compare the worthiness of the different policy goals - invading Iraq versus stabilizing carbon dioxide - as an arbiter of the effectiveness of policy advice. Advice provided in support of desired policy objectives is evaluated by standards different from those applied to advice that supports undesired policy objectives. Such a stance ultimately leads to an unhealthy politicization of expert advice, in which judgments about the worthiness of ends to be achieved are substituted for a careful evaluation of the policies to be employed in reaching those ends.

Of course, to expect a project such as ADAM to challenge policy commitments or framings would be to look in the wrong place. Unlike the CIA, ADAM was never expected to produce independent advice, much less advice that would critique or expand policy options. Had ADAM taken a more adversarial position, or even introduced a broader range of knowledge into the political discussions, it might simply have found its contributions ignored by policy makers.

A more effective approach - both in the case of ADAM and of US military intelligence - would be to ensure that the relevant advisory process is diverse and connected to formal decision processes, with policy analysts sitting at varied distances from the machinery of decision making.

Creating mechanisms that include the possible introduction of uncomfortable, or even adversarial, policy advice into the political process will likely test the mettle of even the most public-spirited politician - which suggests the need to institutionalize analytical diversity as part of the policy process. Ultimately, resolving the policy analyst's dilemma requires that policy makers commit to hearing what analysts have to say and not simply what the policy maker wants to hear - presenting policy makers with a dilemma of their own.

References

1. http://www.liu.se/forskning/foass/eva-lovbrand/publications?l=en

2. http://www.adamproject.eu/

3. http://ec.europa.eu/clima/policies/package/index_en.htm

4. http://www.perseusacademic.com/book/paperback/the-climate-fix/9780465025190

Lessons of the L'Aquila Lawsuit

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In 1997 the city of Grand Forks, North Dakota, saw devastating flooding that caused billions of dollars in damage. Remarkably, that spring flood could be seen coming for months in advance, since the rising waters were the consequence of melting snow that had accumulated over the winter. Yet, even with the ability to anticipate the record flood crest long in advance, the community was taken by surprise by the flood, with some residents having to evacuate in the middle of the night as rising waters threatened their homes.

Following the disaster, I was a member of the US National Weather Service team sent to investigate the production and use of forecasts where something had obviously gone badly wrong. The lessons from that experience can help to shed some light on the current situation in L'Aquila, Italy, where seven officials are currently embroiled in a lawsuit brought by the affected community over statements the officials had made prior to the deadly earthquake in April, 2009.

On March 31, 2009, in L'Aquila, six days before a deadly magnitude 6.3 earthquake killed 308 people, Bernardo De Bernardinis, then deputy chief of Italy's Civil Protection Department , and six scientists who were members of a scientific advisory body to the Department (the Major Risks Committee) participated in an official meeting and press conference in response to public concerns about short-term earthquake risks. The public concerns were the result of at least two factors: One was the recent occurrence of a number of small earthquakes. A second factor was the prediction of a pending large earthquake issued by Gioacchino Giuliani, who was not a seismologist and worked as a technician at Italy's National Institute of Nuclear Physics.

The deputy chief and scientists held a short one-hour meeting and then a press conference, during which they downplayed the possibility of an earthquake. For instance, De Bernardinis went so far as to claim that the recent tremors actually reduced earthquake risks: "[T]he scientific community continues to confirm to me that in fact it is a favourable situation, that is to say a continuous discharge of energy."[1] When asked directly by the media if the public should sit back and enjoy a glass of wine rather than worry about earthquakes, De Bernardinis acted as sommelier: "Absolutely, absolutely a Montepulciano doc. This seems important."[2]

As news of the L'Aquila lawsuit has spread around the world, many scientists have rushed to the defense of the Committee by highlighting statements made during the meeting that emphasized the uncertainties in any sort of earthquake prediction. For example, *Nature* reported that at the one-hour meeting the scientists made the following nuanced statements: "A major earthquake in the area is unlikely but cannot be ruled out," and "in recent times some recent earthquakes have been preceded by minor shocks days or weeks beforehand, but on the other hand many seismic swarms did not result in a major event," and also "because L'Aquila is in a high-risk zone it is impossible to say with certainty that there will be no large earthquake."[3]

In the face of these various statements, the lawsuit takes note of the "inexact, incomplete and contradictory information" in its allegations of culpability. While the case is still to be adjudicated under Italian law, some practical lessons can already be drawn by comparing the experience to that which I observed back in 1997 in Grand Forks, North Dakota.

One lesson is that the message sent by the government and its scientists might not be the same one received by the public. In the case of Grand Forks, the weather service issued a forecast of a flood crest of 49 feet – a record flood – two months in advance. The point, they explained to our investigative team, was to communicate to the public that they should expect a record flood and, thus, be very concerned. However, the previous record flood was only a few inches below 49 feet, so instead of causing concern, the forecast prompted the opposite reaction. Residents recalled that the earlier flood had caused relatively little damage, and concluded that a flood cresting only a few inches higher would be no big deal.

Similarly, in L'Aquila, the government and its scientists seemed to be sending a different message to the public than the one that was received. Media reports of the Major Risk Committee meeting and the subsequent press conference seem to focus on countering the views offered by Mr. Giuliani, whom they viewed as unscientific and had been battling in preceding months. Thus, one interpretation of the Major Risks Committee's statements is that they were not specifically about earthquakes at all, but instead were about which individuals the public should view as legitimate and authoritative and which they should not.

If officials were expressing a view about authority rather than a careful assessment of actual earthquake risks, this would help to explain their sloppy treatment of uncertainties. Here, too, the North Dakota experience is relevant. The actual flood crest was 54 feet at Grand Forks, exceeding the 49-foot outlook by 5 feet, and caught the community by surprise as they had only built their levees to 51 feet. The average error in previous flood outlooks in the region was a very respectable 10% (about 5 feet, if applied to the 49-foot outlook), but this information was never shared with the public. When we asked officials why this information was not released with the forecast, they told us they were worried that if information about uncertainties was known then the public would lose confidence in the forecasts.

The L'Aquila court case has prompted much discussion and debate in the scientific community. Many scientists have explained that there is no possibility of offering accurate or useful earthquake forecasts, as was expressed in an open letter to Silvio Berlusconi signed by 5,000 scientists: "Years of research worldwide have shown that there is currently no scientifically accepted method for short-term earthquake prediction that can reliably be used by Civil Protection authorities for rapid and effective emergency actions."[4] Yet such a view is not universal in the scientific community. For instance, Stanford University issued a press release discussing the case in Italy and countering that earthquakes could in fact be anticipated in some cases. Greg Beroza, chair of Stanford's Department of Geophysics, has called for more forecasts: "[W]e have to make earthquake forecasting as routine as weather forecasting."[5]

This context holds several lessons for the scientific community. First, effective communication of nuance and uncertainty is difficult in the best of cases, and there is often a wide range of perspectives on the state of the science. But it becomes even more difficult when messages are being sent to the public via information that may be heard one way among experts and another among the public. When forecasters in Grand Forks intended to send a message of alarm, the public instead received a message of complacency. Similarly, scientists in L'Aquila seemed to want to send a message about authority and proper expertise, but the public received a message of complacency in the face of an ever-present risk.

Another lesson is that debates over forecasts and uncertainty often overshadow knowledge that is far more certain. Paul Somerville and Katharine Haynes of Macquarie University note wryly that "no action has yet been taken against the engineers who designed the buildings that collapsed and caused fatalities, or the government officials who were responsible for enforcing building code compliance."[6] The real tragedy of L'Aquila may not be that scientists led the public astray with their bumbled discussion of predictive science but, rather, that our broader obsession with predictions blinds us to the truths right before our eyes.

References

1. http://www.economist.com/node/21529006

2. http://ca.news.yahoo.com/trial-opens-against-scientists-accused-giving-misleading-big-132746544.html.
Reference for quote: http://www.guardian.co.uk/science/2011/sep/20/italian-scientists-trial-predict-earthquake.

3. http://www.nature.com/news/2010/100622/full/465992a.html

4. http://dotearth.blogs.nytimes.com/2011/09/22/italys-unfounded-earthquake-prosecutions/

5. http://news.stanford.edu/news/2011/september/systematic-earthquake-forecast-093011.html

6. http://theconversation.edu.au/manslaughter-trial-of-laquila-earthquake-scientists-will-cause-serious-aftershocks-3477

Innovation Policy Lessons of the Vasa

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On a chilly day in Stockholm last month, I visited the Vasa museum. Situated on the waterfront, the museum holds a sailing ship that sank in the Stockholm harbor on its maiden voyage in 1628. The ship had barely made it a kilometer from the dock that fateful August day, when it began to roll, letting water into its open cannon ports and then quickly sinking to the bottom. The Vasa took with it the lives of about 40 people and only the top of its tallest mast was left above water. The ship was raised in 1961, and in 1990 was moved to its current location in a giant building that holds the restored ship in its entirety.

The Vasa was to be a technological marvel of its day, during a period when "international competitiveness" had a familiar meaning. Based on the perception that Sweden was losing ground in the race for naval technology, particularly to neighboring Denmark, Swedish King Gustav II Adolph (better known in English as Gustavus Adolphus) had commissioned the bigger and better-armed Vasa. As I explored the museum that day, I couldn't help but think that the tragedy of the Vasa and its fate since that day more than 380 years ago hold lessons for how we think about contemporary innovation policies.

1. Politicians have a long history of meddling in technology implementation

According to the lore of the Vasa, the ship's design had been altered by the King, who had proposed changes such as adding a second gun deck and bigger cannons. Yet the Swedish shipbuilders had little experience building such a vessel. The ship wound up being top-heavy, which contributed to its sinking. The King's interference in the design and building of the ship was one factor that led to the disaster.[1]

This experience reminded me of a story told by Edward David, science advisor to Richard Nixon, when I interviewed him at a public forum in 2005.[2] David recounted how President Nixon wanted to cancel several of the last Apollo moon missions out of concern that an accident might hurt his re-election chances in 1972. The moon mission was moved to December, 1972, a month after the election. No tragedy resulted, but both Vasa and Apollo show that technologies are often subject to the whims of larger political forces.

2. Institutional factors can inhibit effective decision making

Söfring Hansson, the captain of the Vasa, was well aware that the ship was not seaworthy. Prior to the maiden voyage, Captain Hansson had demonstrated to a vice admiral that the ship was unbalanced. He had 30 men run back and forth across the upper deck, causing the ship to roll. The demonstration was stopped after the third pass, out of fear that the Vasa would capsize right there at the dock. Despite this knowledge, the Vasa set sail soon thereafter.

The dynamics here are similar to those that preceded the loss of the Space Shuttle Challenger in 1986. Less than a year earlier, an engineer working for the NASA contractor had written a memo raising concerns about the performance of the shuttle's solid rocket boosters in cold conditions. This information never reached NASA decision makers on the freezing January day that Challenger was launched. Both experiences show that good information does not always lead to good decisions.

3. Performance is the ultimate test of technology

The short voyage of the Vasa showed clearly that the design of the ship was deeply flawed. It was a costly and embarrassing lesson that we are still discussing centuries later. The obvious lesson is that major innovations should be tested carefully before full-scale deployment. We are still learning these lessons today, of course, but there are far more positive lessons to take from Vasa as well.

The salvage and restoration of the ship has provided a fertile laboratory for the science of historical preservation, including advances in chemistry such as the removal of iron from Vasa's wood. The lessons of the Vasa are thus of broad relevance to historians and museums around the world who seek to preserve perishable historical artifacts. It is one thing to discuss and debate technologies of preservation, it is quite another to practice them. The Vasa has proved to be an unexpected and valuable laboratory for learning while doing.

4. We should celebrate and learn from failure as necessary for success

In the United States, much has been made of the bankruptcy of a solar company, Solyndra, which had received loan guarantees from the Obama Administration. The debate follows a predictable pattern with the failure of a single company used as evidence of a poor approach to innovation policy or even wrongdoing. But Solyndra aside, discrete failures in innovation need not indicate flawed innovation polices, as failures can be significant opportunities for learning and ultimately for success.

Indeed, the Vasa museum is a prominent celebration of a failure, with the experience used to understand why the ship foundered, the lessons of its recovery, and to take advantage of the opportunity to learn about the history of the 17th century. Famous failures often find a home in business school case studies, but they should also find a home in our technology policies. Successful innovation means taking risks, and taking risks means some successes but many failures as well. Innovation policies with the greatest chance for success will build in an expectation for failure, to help avoid the predictable politicization.

5. Life is different today

One fascinating part of the Vasa museum exhibits includes a presentation and discussion of some of the people whose remains were recovered along with the Vasa. All were small people, especially compared to the sturdy Swedes one sees today around Stockholm. Most had poorly healed injuries, bad teeth, and signs of malnutrition. Even King Gustav II Adolf, whose clothing can be seen at the Royal Armory in the basement of the Swedish Royal Palace, was a small fellow, although no doubt better fed than those whose remains were found at the bottom of the harbor. Just a quick glimpse into life in 17th century Stockholm provides revealing insights into how much science, technology, and innovation have transformed our lives.

It is difficult to imagine how people 380 years from now will look back on our time and what they will say about our lives and our technology. What will historical museums of the future reveal about us?

References

1. http://www.vasamuseet.se/en/The-Ship/The-sinking/

2. http://cstpr.colorado.edu/scienceadvisors/david_transcript.html

The Great American Manufacturing Battle

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Currently, politicians, academics, and pundits in the United States are arguing over the need for and consequences of innovation in the 21st century economy. One important part of this debate involves the role of manufacturing in employment and economic growth, and the degree to which public policy should focus on treating manufacturing as a "special sector" that deserves targeted government support. In this column, I'll provide a bit of an overview of this debate and some historical data on the role of manufacturing in the economy.

On one side of the debate you have the manufacturing romantics, who see the sector as occupying a special place in the economy, thus deserving unique support from government. For instance, Laura D'Angela Tyson, chair of the White House Council of Economic Advisors under Bill Clinton, has argued that "a strong manufacturing sector matters – and deserves the attention of policy makers." She makes the case that manufacturing is special because of its role in exports, its potential for employment growth, and its overwhelming role in supporting industrial investments in innovation.[1]

On the other side of the debate you have the manufacturing skeptics, who see the sector as one of many important sectors and not deserving of special government treatment. One representative of this position is Christina Romer, who also served as chair of the Council of Economic Advisors for Barack Obama. Romer writes: "Public policy needs to go beyond sentiment and history. It should be based on hard evidence of market failures, and reliable data on the proposals' impact on jobs and income inequality," and ultimately concludes: "So far, a persuasive case for a manufacturing policy remains to be made."[2]

The first thing to notice about this debate is that it does not, like so many issues on American political discourse, follow from partisan political positions. Both Romer and Tyson are Democrats who served in Democratic administrations. Indeed, writing at *Bloomberg Businessweek*, Joshua Green has noted that, despite arguing over just about everything else, "President Barack Obama and the Republican candidates do seem to share the common conviction that it is not just desirable but a matter of urgent national concern to revitalize U.S. manufacturing."[3]

To make sense of this debate requires understanding the role of manufacturing in the overall US economy. The US government collects plentiful data on the economy by breaking it down into various sectors that include familiar categories such as agriculture and mining. The changing nature of the economy has led to changes in the categorization, such as the introduction of "information" as a new sector in 1998.

Today, the US manufacturing sector has about 12 million workers, or 8 percent of the total workforce – about 150 million people. Manufacturing comprises about 12 percent of the total US economy. Despite the fact that manufacturing makes up a relatively small proportion of the economy, industries in the sector are responsible for about 70 percent of all industry research and development in the US, and industry overall conducts about twice as much R&D as that supported by the federal government.

However, a snapshot of the current state of manufacturing makes more sense when placed in historical perspective. Over the past decade or so, the number of jobs in manufacturing has declined precipitously. At the start of 2012 there were fewer jobs in US manufacturing than at any time since the early 1940s.[4] The US, of course is not alone in seeing the decrease of employment in manufacturing. Germany, for instance, has seen the number of manufacturing jobs declining for more than 20 years – a decline of about 30 percent since 1990 – and the sector currently employs fewer people than at any time since 1950.[5]

One important reason for the decline in jobs in manufacturing has been the gains in productivity in this sector, meaning that more outputs result from fewer inputs, with labor as one of those inputs. One part of productivity gains has to do with technological innovation that replaces lower-skilled workers; but another part is the opening up of supply chains and trade over the past several decades as a consequence of globalization. Consequently, both technology and trade are the focus of political debates, typically in the context of "bringing back" jobs that have been either displaced by technology or off-shored to other countries.

Manufacturing has also declined as a share of the overall US economy, from about 24 percent in 1970 to about half that amount today. This decline mirrors a similar decline in the global economy, and in many nations around the world. Economist Mark Perry at the University of Michigan observes: "Australia's manufacturing/GDP ratio went from 22 percent in 1970 to 9.3 percent in 2010, Brazil's ratio went from 24.5 to 13.5 percent, Canada's from 19 to 10.5 percent, Germany's from 31.5 to 18.7 percent, and Japan's from 35 to 20 percent."[6]

Despite the fact that manufacturing jobs have declined and the sector represents a smaller percentage of economic activity, it would be a mistake to conclude that the sector is in decline. Since 1950, manufacturing output has increased in the US by 300 percent after factoring out inflation, and manufacturing has bounced back strongly after a sharp decline during the global financial crisis.

Over the past decade, the US manufacturing sector has increased its investments in research and development. For instance, in 2002 the R&D intensity (measured as the R&D expenditures divided by the sector's contribution to GDP) was 3.7 percent, and in 2007 it had increased to 4.4 percent. Consequently, even as manufacturing declined overall as a portion of the US economy, industrial R&D increased as a share of GDP in that same time period. Indeed, increased R&D spending may be a consequence of the manufacturing sector moving away from low-skilled labor.

My reading of these data leaves me siding with the arguments put forward by Christina Romer rather than Laura D'Angela Tyson: Manufacturing is indeed important, but it is no more special to the economy than is the multitude other sectors that comprise about 90 percent of jobs and economic activity. There are certainly better and worse government policies in support of innovation and the economy, and a focus on health care, education, immigration, and taxes generally makes more sense than creating special policies in support of particular sectors of the economy. The manufacturing romantics will have to do a much better job arguing for the uniqueness of that sector, as I am not yet convinced.

As the 2012 US election heats up, we can be sure that the great manufacturing battle will continue in the political arena. The fact that academics and pundits are debating a number of questions that can be addressed empirically gives hope that the debate might see some sort of consensus reached. However, whether politicians would accept such a consensus is another issue altogether.

References

1. http://economix.blogs.nytimes.com/2012/02/10/why-manufacturing-still-matters/

2. http://www.nytimes.com/2012/02/05/business/do-manufacturers-need-special-treatment-economic-view.html

3. http://www.businessweek.com/articles/2012-03-08/the-manufacturing-myth-that-both-parties-cling-to

4. http://rogerpielkejr.blogspot.com/2012/02/politics-and-economics-of-manufacturing.html

5. http://research.stlouisfed.org/fredgraph.png?g=5JL

6. http://mjperry.blogspot.com/2012/01/decline-of-manufacturing-is-global.html

Science, Sex, and the Olympics

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Early in the 19th century, the English poet Robert Southey explained that little girls are "sugar and spice, and all things nice" while little boys are "snips and snails and puppy dog tails." Such descriptions are apparently not rigorous enough to determine who gets to participate in women's events in the Olympics, so last month the International Olympic Committee (IOC) issued new regulations on the eligibility of athletes to participate in women's events in the upcoming London Games.

The new regulations seek to head off controversies such as erupted at the Track and Field World Championships in 2009, when South African runner Caster Semenya's victory in the 800 meters was followed by accusations that she had competed unfairly in a women's event. The response to the accusations focused on applying a "gender test," which was embarrassing for the body that governs track and field and demeaning to Semenya, and ultimately did little to clarify things.

The issues here are much broader than just competition categories at the Olympics and go to the heart of the challenges in using science in decision making. Decisions are almost always formulated in binary categories: pass the legislation, sign the treaty, implement the law – or not. In the case of the Olympics, a binary decision is whether the athlete should compete as a man or woman, since these are the two categories of the games.

But it turns out that the science of gender is not so straightforward, and human evolution has not made us all so that we easily fit into binary categories. The IOC recognizes this and explains that human biology "allows for forms of intermediate levels between the conventional categories of male and female." Recognizing this ambiguity, the IOC explains: "Nothing in these Regulations is intended to make any determination of sex."

Instead, it has tried to implement a regulation that uses science as a proxy for determining sex. Writing in *The New York Times*, a medical geneticist who advised the IOC argued that science could resolve this issue[1]: "Let's forget for a while about gender identity politics" and focus on "one parameter that ... could entirely explain why men did better than women in elite sports." The proposed candidate parameter is biological levels of testosterone, admittedly imperfect but apparently serviceable.

The IOC explains that female athletes with levels of androgenic hormones that "fall into the male range" that confers a "functional" competitive advantage will be disqualified from competing in women's events.

The IOC makes an explicit comparison between those athletes who have doped by taking steroids and those athletes whose bodies produce excessive levels of hormones. Such athletes can now be considered naturally doped – an oxymoron that betrays the illogic of the regulation.

Not only are the proposed regulations ambiguous – what is "the male range"? How is "functionality" determined? – but they are based on a selective reading of the science of sex and athletic performance. Despite a widespread belief that testosterone is the "one parameter" that determines athletic performance, the science is far more ambiguous. Writing in an academic paper published earlier this month, a team of researchers criticized the IOC's focus on testosterone, arguing: "The current scientific evidence, however, does not support the notion that endogenous testosterone levels confer athletic advantage in any straightforward or predictable way."

Like so many areas of decision making, the science of gender does not provide distinct lines that can make politics go away and render decision making straightforward. And gender is not the only such issue facing the IOC. The case of another South African athlete, Oscar Pistorius, who runs on artificial legs, has raised questions about the boundary between the Olympic Games and the Paralympic Games.

Further, why stop the regulations at outlier levels of testosterone? What about regulating rare levels of human growth hormone, or red blood cells, or heart capacity? The list could go on forever.

Science, and the evidence that it produces, can often add insight to decision making. We must be prepared, however, to accept that one such insight may be that the world is complicated, colored in infinite shades of grey. Very rarely does science provide clear demarcations. Rather than providing clarity, further scientific investigation may add new perspectives, new knowledge, and new questions that only diversify our palette.

Decision making in the Olympic sphere, as in many other human endeavors, is always going to be deeply political and social. This means that outcomes we view as legitimate must be negotiated and will always be provisional – even the decision of what it means to compete in the women's category at the Olympics. Leaning on science to make our difficult choices can lead to bad decisions and, sometimes, to politicized science.

References

1. http://www.nytimes.com/2012/06/18/sports/olympics/the-line-between-male-and-female-athletes-how-to-decide.html?_r=3&pagewanted=all

The Origins of "Basic Research"

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In any discussion of government science policies, it rarely seems to take long for someone to invoke the notion of "basic research." For instance, writing in The Washington Post last month[1], Alan Leshner, CEO of the American Association for the Advancement of Science, and US Representative Jim Cooper (D-TN) announced the "Golden Goose Awards" to "recognize the often-surprising benefits of science to society."

In their appeal for more funding for scientific research, Leshner and Cooper argued that: "Across society, we don't have to look far for examples of basic research that paid off." They cite the creation of Google as a prime example of such payoffs: "Larry Page and Sergey Brin, then a National Science Foundation [NSF] fellow, did not intend to invent the Google search engine. Originally, they were intrigued by a mathematical challenge ..."

The appealing imagery of a scientist who simply follows his curiosity and then makes a discovery with a large societal payoff is part of the core mythology of post-World War II science policies. The mythology shapes how governments around the world organize, account for, and fund research. A large body of scholarship has critiqued postwar science policies and found that, despite many notable successes, the science policies that may have made sense in the middle of the last century may need updating in the 21st century.

In short, investments in "basic research" are not enough. Benoit Godin has asserted[2] that: "The problem is that the academic lobby has successfully claimed a monopoly on the creation of new knowledge, and that policy makers have been persuaded to confuse the necessary with the sufficient condition that investment in basic research would by itself necessarily lead to successful applications." Or as Leshner and Cooper declare in The Washington Post: "Federal investments in R&D have fueled half of the nation's economic growth since World War II."

A closer look at the actual history of Google reveals how history becomes mythology. The 1994 NSF project[3] that funded the scientific work underpinning the search engine that became Google (as we know it today) was conducted from the start with commercialization in mind: "The technology developed in this project will provide the 'glue' that will make this worldwide collection usable as a unified entity, in a scalable and economically viable fashion." In this case, the scientist following his curiosity had at least one eye simultaneously on commercialization.

Since graduate school in the early 1990s, I have observed the durability and sustainability of the mythology of "basic research" as a key political symbol in science policy[4]. So several years ago I started a research project (funded by the NSF) to document the origins of the phrase. My findings have recently been published in the 50th anniversary issue of *Minerva* ("Basic Research as a Political Symbol"[5].

I discovered that the phrase "basic research" originated around 1920 in the United States' agricultural community, where "research" was described as "the basic work" of the Department of Agriculture. The phrase was shortened to simply "basic research" and its usage slowly expanded in the 1920s and 1930s, but without the meaning it carries today. Ironically, "basic research" began as a phrase meaning what today we call "applied research."

During the period between the World Wars, scientists in both the US and UK sought to expand their role in government, as well as government's role in supporting science – in both instances with limited effect. During this time, scientists continued to appeal for government support of "fundamental" or "pure" research conducted with little or no consideration of its application. On both sides of the Atlantic such arguments, not surprisingly, found little political support.

Not until World War II did governments decide that large-scale support of scientific research was an appropriate role for public investment. As has been well chronicled, the change in orientation was reflected in Vannevar Bush's Science – *The Endless Frontier*[6], which marked the transformation of "basic research" into a political symbol representing a powerful conception of the role of science in society.

Bush's decision to use the phrase was conscious and strategic, as he explained in his memoirs: "To persuade the Congress of the pragmatically inclined United States to establish a strong organization to support fundamental research would seem to be one of the minor miracles ... When talking matters over with some of these [people on Capitol Hill], it was well to avoid the word fundamental and to use basic instead."

Up to that point, science policy in government had been almost exclusively the domain of agriculturists. Henry A. Wallace, who served as secretary of agriculture under President Franklin Roosevelt and later as his vice president, is an important figure in science policy whose role has been largely overlooked. At the start of the war, Wallace was the key figure in science policy and the leader to whom Vannevar Bush reported. By the end of the war, Wallace's political fortunes had fallen and the physicists were in charge of science policy, a role that has continued until today in the position of science advisor to the US president, which has been occupied by physicists for more than 50 years.

After the war, the usage of the phrase "basic research" increased dramatically in the elite media, in Congress, and within the scientific community. Interestingly, the usage increased and peaked first in the media, next in Congress, and lastly within the scientific community – a pattern supporting Bush's claim that the phrase was politically expedient. Yet, despite its fall from favor, it remains a core concept in contemporary discussions of science policy.

A key reason for the durability of the phrase is that it can simultaneously convey opposite meanings to different audiences. For many scientists, "basic research" means "fundamental" or "pure" research conducted without consideration of practical applications. At the same time, policy makers see "basic research" as that which leads to societal benefits including economic growth and jobs.

The mechanism that has allowed such divergent views to coexist is of course the so-called "linear model" of innovation, which holds that investments in "basic research" are but the first step in a sequence that progresses through applied research, development, and application. As recently explained in a major report of the US National Academy of Sciences: "[B]asic research ... has the potential to be transformational to maintain the flow of new ideas that fuel the economy, provide security, and enhance the quality of life" (*Rising Above the Gathering Storm*[7]).

In recent decades, use of the phrase "basic research" has been in decline. The scientific community has tried out an impressive range of alternative phraseology – "fundamental," "transformative," "transformational." Academics have also provided suggestions – "use-inspired," "collaboratively assured," "Mode 2." To date, no key symbol has displaced "basic research" for the simple reason that no model of science policy has yet displaced the postwar consensus. If and when such a shift occurs, it will not only be our institutions that change but our language as well.

References

1. http://www.washingtonpost.com/opinions/its-time-to-get-serious-about-science/2012/09/09/5b5c1472-f129-11e1-892d-bc92fee603a7_story.html

2. http://www.csiic.ca/PDF/TheMakingOfScience.pdf

3. http://www.nsf.gov/discoveries/disc_summ.jsp?cntn_id=100660

4. http://www.sciencemag.org/content/269/5230/1531.extract?sid=b5384d88-c4d1-4591-aa6c-6ff87921bce8

5. http://sciencepolicy.colorado.edu/admin/publication_files/2012.20.pdf

6. http://archive.org/details/scienceendlessfr00unit

7. http://www.nap.edu/catalog.php?record_id=11463

Mad Cows, Hurricane Sandy, and Why We Need Strong Science Assessors

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Last month in Berlin, I participated in the 10th anniversary conference of the German Federal Institute for Risk Assessment – the Bundesinstitut für Risikobewertung (BfR). The BfR is one of a number of European organizations that Catherine Geslain-Lanéelle, executive director of the European Food Safety Authority (EFSA), characterized at the conference as "the children of Mad Cow disease." This group of siblings includes the EFSA, departmental chief scientific advisors in the UK, and others. These organizations, and the conditions under which they were created, remind us that if science is to be well used in policy and politics, then strong institutions are necessary. This is a lesson continuously relearned, most recently in the United States in the aftermath of Hurricane Sandy.

In the 1990s, as the British public became aware that bovine spongiform encephalopathy (BSE) among cattle was being transmitted to humans, the initial response of government scientific advisory bodies was to downplay the risk. Many remember the cringe-worthy spectacle[1] in 1990 of the UK Agriculture Minister John Gummer feeding his young daughter a hamburger in public to demonstrate the safety of British beef. Fewer, however, remember Nature magazine conveying a similar message not long afterwards – admitting some risks, but claiming "the raw materials of cattle feed are now tightly controlled, while there are rigorous inspections of meat sent for sale." Such claims were "nonsense" according to University of Newcastle historian John Fisher who explained that, contrary to Nature's assertion, "the gap between regulation and actual practice was glaring" throughout the early 1990s.

The result of this gap, when broadly recognized, was public panic and, ultimately, reform of the mechanisms of science advice in the UK and across Europe, including creation of the institutions characterized as the "children" of Mad Cow disease. Such reforms were designed not only to improve the scientific basis for judgments of risk, but also to fortify public trust in government science bodies and to better ensure that scientific information had a legitimate role to play in decision making.

Like any large family, the children of Mad Cow disease have attained differing degrees of success. In many respects, the BfR stands out as a model of best practices. Its 2010 Guidance Document for Health Assessments deserves to be widely emulated and its recommendations put into practice wherever governments seek to institutionalize expert input on scientific questions. By contrast, the EFSA has recently faced allegations of conflicts of interest, and the chair of its management board was forced to resign earlier this year due to contemporaneous service on the board of a food science advocacy group.

In the UK, a recent House of Lords report on the establishment of Chief Scientific Advisors across government departments appeals to the same "trust us, we're scientists" mode of advice that arguably contributed to the Mad Cow affair in the first place. Clearly, the establishment of institutions with a mandate to assess science is no guarantee of success. Constant evaluation and oversight are necessary.

Hurricane Sandy damage on Long Beach IslandIn the United States, the importance of having strong scientific institutions is one lesson to be drawn from the aftermath of "Hurricane Sandy," which caused tens of billions of dollars in damage along the northeastern coast.

In 2011, in the aftermath of Hurricane Irene's severe impacts in New England, a number of state governments decided to take steps to better align the risks of living on the coast with the costs of insurance – a policy that most would agree makes good sense. At least five states, including New York and New Jersey, enacted legislation to create what is called a "hurricane deductible"[2] feature of insurance policies. Normally, when a homeowner suffers property damage, s/he is responsible for the initial cost of repairs and insurance covers costs above this amount. The homeowner's responsibility is typically a small amount compared to the value of the home: perhaps $2,000. The idea behind the "hurricane deductible" feature was to dramatically increase the initial homeowner responsibility, thereby exposing the homeowner to a much higher loss in the event of a disaster – in some cases as much as $25,000 or more.

While different states have different rules, in general the "hurricane deductible" would apply only if the event causing the damage was in fact a "hurricane." And here is where the trouble begins.

The US government agency that tracks hurricanes and issues warnings is the US National Hurricane Center (NHC). As Sandy approached the New Jersey coast as a hurricane in late October, the NHC recategorized Sandy just one hour before the storm made landfall as a "post-tropical cyclone."[3] Officially, the storm was no longer a hurricane.

The consequences of the NHC's decision to recategorize Sandy were financially significant, as it meant that the "hurricane deductible" would no longer apply to those who suffered damage from the storm. As a result, individual homeowners' shares of the losses decreased by an order of magnitude, and the insurance industry's liabilities increased by many billions of dollars.

In the immediate aftermath of Sandy's landfall, reports surfaced about potential lawsuits from the insurance industry over Sandy's reclassification. Governor of New Jersey Chris Christie sought to head off such claims by issuing an executive order that legally defined the storm as not being a hurricane. Senator Charles Schumer of New York wrote a letter to the National Weather Service (NWS) requesting[4] that they keep Sandy defined as a "post-tropical cyclone" and reminding the agency of the costs to his constituents of their decision. For its part, the National Weather Service had created an ad hoc committee to investigate its performance on Sandy, to be cochaired by an external critic of the agency's performance and recategorization. The NWS immediately reversed course and canceled the investigation committee, only to reconstitute it comprising only NWS employees.

Whatever role science might have played in the implementation of the "hurricane deductible" clause, such a role is no longer feasible. Decisions about who bears the costs of Sandy's property damage will likely be made politically, based on the competing interests and political power of those with the most at stake. This outcome can be traced to the 2011 passage of legislation by the states that created the "hurricane deductible" concept – arguably a useful idea in principle – but then tying its implementation to scientific judgments that are not at all tailored to the needs of a regulatory, legal, or legislative process. The lack of institutions fit for that purpose means that the intent behind the notion of a "hurricane deductible" has been thwarted.

The same important lesson should be learned from our experiences with the responses to Mad Cow disease and to Hurricane Sandy – to be successful, policies that depend on scientific judgments require strong scientific institutions that can render those judgments. The experiences of the "children" institutions of the Mad Cow experience born to European governments tell us that effective science arbitration is not easily put into practice, even when a need is recognized. Hurricane Sandy reminds us of what can occur when such a need goes unrecognized. The continued effective use of science in policy making means that we must remain ever vigilant to the integrity of institutions that sit at that interface.

References

1. http://news.bbc.co.uk/onthisday/hi/dates/stories/may/16/newsid_2913000/2913807.stm

2. http://www.insurancejournal.com/news/national/2012/11/02/269033.htm

3. http://www.ncdc.noaa.gov/news/summary-information-post-tropical-cyclone-sandy4. http://www.sciencemag.org/content/269/5230/1531.extract?sid=b5384d88-c4d1-4591-aa6c-6ff87921bce8

4. http://thehill.com/blogs/e2-wire/e2-wire/267261-schumer-presses-weather-agency-to-keep-sandy-a-storm

Overcoming the Tyranny of the Stylized Fact

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When Thomas Herndon's professors at the University of Massachusetts asked the students in their graduate economics seminar to replicate an analysis in a published paper, little did they know that the results of Herndon's homework would soon be the talk of the discipline[1]*. The episode has been the focus of much discussion among economists but offers much broader lessons for how we think about the relationship between academic research and policy making.*

As has now been widely reported, Herndon and his professors, Michael Ash and Robert Pollin, were unable to replicate the findings of a widely influential paper by Carmen Reinhart and Kenneth Rogoff[2]*, which claimed to find a "threshold for public debt ... Above 90 percent, median growth rates fall by one percent." The apparent debt threshold had been widely cited in debates over government austerity policies in Europe and the United States. After Reinhart and Rogoff shared their working spreadsheet, the Massachusetts researchers, identified several questionable methodological choices as well as an embarrassing error in the Excel file, subsequently described in a discussion paper*[3]*.*

Economics, like many other academic disciplines, often finds its way into policy debates via what the discipline calls "stylized facts," which is usually taken to mean economic findings that hold generally, if not in all instances. In principle, the "stylized fact" thus provides the policy maker with a useful starting point for debate about alternative courses of action.

Unfortunately, the "stylized fact" – in economics and beyond – is often more effective for clouding debate than for clarifying it.

In their critique, Herndon and colleagues observed that Reinhart and Rogoff sought "to build the case for a stylized fact" and dryly pointed out that "a necessary condition for a stylized fact is accuracy." However, the Massachusetts team is not quite right about the notion of "stylized fact" – accuracy is in fact secondary.

The phrase was first introduced in 1962 by Nicholas Kaldor, an economist at Cambridge University, to suggest how economists should build theoretical understandings. He wrote that the theorist "should be free to start off with a 'stylized ' view of the facts – i.e., concentrate on broad tendencies, ignoring individual detail ... without necessarily committing himself on the historical accuracy, or sufficiency, of the facts or tendencies thus summarized."

There is a big difference between simplifying the world's complexity in order to build generalizable theoretical models and simplifying the world's complexity in order to inform practical action. Context, nuance, and detail hardly matter for generalizable academic theory, but in policy making they can mean everything. The "styled fact" is thus an aid to theoreticians, and as such, should always be approached warily by policy makers.

Several years before the "stylized fact" was coined, John Kenneth Galbraith, Harvard economics professor and a contemporary of Kaldor's, popularized the phrase "conventional wisdom"[4] to describe "ideas which are esteemed at any time for their acceptability." Galbraith gave the phrase a negative connotation, explaining that the ideas that constitute the conventional wisdom are often resistant to challenge: "they yield not to the attack of other ideas ... what is convenient has become sacrosanct."

The resistance comes from two directions: First, there are policy makers who depend upon the authority of expertise to buttress their political agendas. Jared Bernstein, a former advisor to President Obama, explained why the critique of the Reinhart and Rogoff paper would not have much impact on the public debate over austerity: "Why wouldn't we expect a reaction from policymakers? Because they're using research findings the way a drunk uses a lamppost: for support, not for illumination."[5]

That politicians often use research expediently should come as a surprise to no one. Nor is it surprising that researchers may seek fame and influence by providing analyses that can serve as lampposts. Yet, in any system as complex as the economy, there will be ample data, methods, and perspectives for scholars to construct legitimate arguments that might be enlisted by just about any political perspective. Dan Sarewitz, at Arizona State University, has called this dynamic an "excess of objectivity[6]." He explains: "Science is sufficiently rich, diverse, and Balkanized to provide comfort and support for a range of subjective, political positions on complex issues such as climate change, nuclear waste disposal, acid rain, or endangered species." To that list we can add economics too.

In the face of politicians who cherry-pick, academics who enable them, and those who don't (but nevertheless contribute to filling the metaphorical bowl of ideas with ever more cherries), it would be easy to throw one's arms in the air and abandon any hope of better connecting expertise with decision making.

But not all hope is lost. Academics can take two important steps to militate against the tyranny of the "stylized fact" as conventional wisdom.

First, academics can facilitate the understanding and accuracy of published work by making data, methods and, if applicable, computer code publicly available upon publication to facilitate replication by independent parties. Just this month the scientific publisher, *Nature*, is adopting new standards for its publications in the life sciences[7]: "[W]e will more systematically ensure the reporting of key methodological details, give more space to Methods sections, examine the statistics more closely and offer more ways for authors to be transparent about these matters." Such steps should be adopted broadly across disciplines and journals. In the case of Reinhart and Rogoff, a long delay in releasing their data spreadsheet allowed their error to go uncorrected and their methods uncritiqued.

Second, in policy making, debates about "facts" often substitute for open debates about alternative courses of action. Experts and policy makers seeking to improve the quality of debates can help to avoid such proxy arguments by focusing attention on policy options. As I have often argued[8], such attention can take the form of advocacy, which seeks to argue for a particular course of action, or honest brokering, which seeks to characterize or even expand the scope of available choices.

Ultimately, we must remember that securing better connections between experts and decision makers guarantees neither that such advice will be heard, nor that it will compel particular decisions. Just a few days after the Reinhart and Rogoff "stylized fact" of a 90%-debt-to-GDP threshold was shown to be badly flawed, Fitch Ratings, the ratings agency, downgraded its credit rating of the United Kingdom, based in part on the 90%-debt-to-GDP threshold[9].

The general lesson here was captured not by an economist but by Mark Twain, who explained, "What gets us into trouble is not what we don't know. It's what we know for sure that just ain't so."[10] To help keep research from turning into the drunkard's lamppost, beware stylized facts and challenge the conventional wisdom.

References

1. http://www.umass.edu/umhome/feature/sorry-wrong-numbers
2. http://www.nber.org/papers/w15639.pdf
3. http://www.peri.umass.edu/fileadmin/pdf/working_papers/working_papers_301-350/WP322.pdf
4. http://books.google.com/books/about/The_affluent_society.html?id=buihYlwXhuwC
5. http://jaredbernsteinblog.com/the-reinhartrogoff-mistake-and-economic-epistemology/
6. http://www.cspo.org/_old_ourlibrary/ScienceandEnvironmentalPolicy.htm
7. http://www.nature.com/ni/journal/v14/n5/full/ni.2603.html?WT.ec_id=NI-201305
8. http://www.guardian.co.uk/science/political-science/2013/apr/30/science-policy1
9. http://ftalphaville.ft.com/2013/04/19/1467582/and-what-took-you-so-long-fitch/
10. http://www.biography.com/people/mark-twain-9512564

Providing Evidence to Policy Makers: an Integration of Expertise and Politics

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Last month I was invited to testify before a hearing[1] of the US Senate's Committee on Environment and Public Works on the science of climate change. It is a privilege to be called upon to share one's expertise with policy makers. Yet most experts, and certainly most academic experts, receive little training in how to engage effectively with policy makers in a formal setting such as an evidentiary public hearing. I am fortunate to have had excellent mentors over the past several decades, who shared with me some key advice for engaging effectively in the policy process. I would like to pass along a bit of their advice, which I have come to appreciate.

Experts who are called to offer evidence in a formal political setting such as a Congressional hearing play a different role from political appointees, who are expected to present, defend, or account for the formal actions of an administration or a government. Generally, there are two types of experts: experts who are also policy advocates, and independent experts.

Experts in the first category typically present testimony in support of a particular political agenda. These experts are usually associated with corporations, think tanks, or other nongovernmental organizations. Congressional staff have told me that elected officials prefer to hear from such experts because the expert's political agenda is explicit. Policy makers are then in a position to hear adversarial arguments and to evaluate claims and counterclaims without needing to guess what hidden agendas might be at play.

Under the US system of receiving testimony before Congress, each political party is allowed to select the experts that they wish to hear testify at a hearing; the party holding the majority determines how many people will be asked to appear and how many will be allocated to the minority party. The risk of such an approach is reminiscent of the old saw about the drunk and the lamppost – expertise can be used more for support than for illumination. For example, at the Senate hearing last month, the only engagement between majority senators and several of the minority's witnesses dealt with who funded the organizations where the experts worked. There was no acknowledgment whatsoever of the substance of their testimony, which was quickly dismissed as tainted by association.

Experts in the second category are independent experts, with "independent" meaning unaffiliated with any organization advocating for a particular course of action. Often, independent experts are chosen because of their role in leading a formalized assessment of knowledge, such as reports of the National Research Council or government science advisory committees. The expert is generally expected to represent the assessment rather than their personal views. Because the assessments are often conducted at the explicit request of policy makers, they constitute an important mechanism for connecting expertise with decision making.

Independent experts not affiliated with formal assessments are also commonly invited to provide testimony. A specific expert is asked to testify because policy makers see some political advantage in having that expert testify. Academics unaffiliated with government, advocacy groups, or formal scientific assessments should quickly disabuse themselves of any notion that they have been invited to "speak truth to power." Rather, they are carefully selected for the perceived political benefits of their testimony.

In my case, I was invited by Republicans on the Senate committee because several Democrats, including President Obama, have recently been making statements about the relationship between human-caused climate change and extreme weather that go well beyond what can be supported based on current scientific understandings. The previous time that I testified before this same committee, I was invited by Democrats. An expert cannot control when their knowledge will be perceived as relevant, or by whom; but when an invitation is received, we have an obligation to participate in the democratic process.

Expertise is commonly brought into the political process through some overt political conflict, as politicians seek to hold each other accountable for public representations that invoke claims grounded in science. This strategy was on display in the Senate hearing, when a Democratic senator queried me on the reality of climate change – an issue on which we agreed – but steered clear of the substance of my testimony, which focused on extreme events.

Experts offering evidence in such an unavoidably political process need to remember that their job is not to tell policy makers what they want to hear, but to provide their best judgment about what the evidence can support on subjects in which they have some expertise. While this is an easy recommendation to make, there is no shortage of experts willing to engage in stealth advocacy by presenting a view of evidence that is friendly to a partisan agenda by engaging in cherry picking of research or even offering misleading or unsupportable testimony. Those tactics were fully on display at the Senate hearing in which I participated, and are unavoidably fundamental to the process.

Each of us "independent" experts afforded the privilege of participating in the democratic process by delivering evidence has to decide what role we wish to play. I have long argued that stealth advocacy by experts -- while seductive and offering a quick route to political impact -- ultimately risks the legitimacy and authority of expertise, especially the ability of the expert community to offer effective science arbitration or honest brokering. The flip side, of course, is that in the context of the most politicized issues, representations of evidence that do not fit a partisan agenda may simply not be welcome in the process, especially if it is equivocal, nuanced, or uncertain.

The expert can reduce the odds of merely serving as a political prop in a larger debate by asking policy makers what specific questions they would like to see addressed in the testimony. In my testimony before the Senate last month, I was asked to testify about extreme weather, a subject I have been researching for more than 20 years. In the vocabulary of The Honest Broker (Cambridge, 2007), I assumed the role of the "science arbiter." I was not asked to share my strongly held views on a carbon tax, light bulb standards, global energy access, or the reform of FIFA. Staying focused requires discipline, restraint, and a healthy respect for the process.

When delivering testimony, it is important that an expert have a clear, overarching conclusion that can be backed up by a manageable number of supporting points. Academics are trained to build arguments from the ground up, piece by piece, ultimately arriving at conclusions; but delivering evidence to policy makers turns academic convention on its head: Lead with your conclusions.

In testimony before the US Congress, witnesses are typically allocated five minutes to deliver oral remarks. This is not much time, but it does encourage one to get to the point. Anyone giving testimony, no matter how experienced, should practice their delivery. Speaking freely is preferable to reading a text, and keeping focused is essential. To become skilled at presenting a coherent, compelling, five-minute message takes a lot of practice. Classroom exercises, including mock hearings, should be far more common in our graduate and professional education.

When giving Congressional testimony, witnesses submit written testimony in addition to the five minutes of oral remarks. This written testimony should be taken seriously, as it offers an opportunity to provide background and details to support the claims made in the oral remarks.

Experts called to testify should recognize that they are speaking to two important audiences. One audience, of course, is the elected officials and their support staff. However, your message is also presented to a far more diverse audience: the media, your peers, other policy makers, and even the public. In an era of Twitter and YouTube, the authority of a formal evidence-gathering process gives the expert a rare platform for communicating to a very broad audience.

Experts who participate in formal processes of evidence gathering would benefit from explicitly considering the roles they might play in the process. Also necessary is a realistic perspective on the inherently partisan nature of political conflict and the tensions between informing the process and supporting a particular agenda. As in other forms of engagement, the challenge lies not in seeking to somehow keep expertise and politics separate, but rather, in achieving an effective integration of the two.

References

1. http://www.epw.senate.gov/public/index.cfm?FuseAction=Hearings.Hearing&Hearing_ID=cfe32378-96a4-81ed-9d0e-2618e6ddff46

Pure Science Ideal and Science Policy

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With apologies to John Maynard Keynes[1], much of what occurs in discussions of science policy is in servitude to the ideas of some defunct scientist from quite a few years back. A fascinating workshop in Bonn, Germany, last month explored the deep historical currents that shape how we think today about the role of science in society.

The concepts that we use in science policy reflect historical debates about class, economics, and politics that exert continuing influence on how we think about the role of publicly supported research in society. Here I will describe some of what stood out for me among the impressive array of historical research presented at the conference workshop.

The notion of the "pure science ideal"[2] has long been part of the history of science policy. It turns out that many of the stories still told today about "pure science" in history may actually be fables constructed to impart lessons. Graeme Gooday of the University of Leeds explained that, a century ago, scientists went to great lengths to construct narratives that reinterpreted applied science not as a unique endeavor but rather as built upon a necessary foundation of previously completed pure science discoveries. Gooday writes[3] that such histories "colonize[d] 'applied science' and reconfigure[d] it as if it were not only a subordinate branch of 'pure science' but somehow – thanks to a considerable resort to amnesia – always had been." This colonization was, of course, to create a future place for "pure science" in government budgets at a time when industry and government were developing a deeper appreciation for the value of research.

The effort to subsume applied science to pure science is more than a bit ironic. Robert Bud of the Science Museum, London, has argued that the notion of "applied science" had been originally promoted in the mid-19th century as a way for academic scientists to argue for their relevance in an era of rapid industrialization. Scientists who wanted to secure public support for their work as well as freedom from oversight – a recurring theme – took to telling stories that privileged their contributions in a certain way, such as in "the certainly apocryphal story of the saintly Faraday telling the evil Prime Minister Gladstone that one day he would tax electricity."

The decades-long debate between the planned science championed by John Desmond Bernal on the left and the anti-communist emphasis by Michael Polanyi on scientific freedom represented another front in the Cold War, one on which intellectual battles had already begun well before World War II. During much of the Cold War, the tension between planning and freedom was mitigated by the so-called linear model of science in society, in which basic research is the antecedent of applied research, which then leads to development and ultimately applications.

The semantic importance of "basic research"[4] – a phrase that entered the English lexicon around 1920 but only became prominent following the 1945 publication of Vannevar Bush's Science: the Endless Frontier – cannot be overstated. Its plasticity as a political symbol allowed scientists to believe that with public funding they were following the pure science ideal while politicians could simultaneously believe that they were making investments in direct response to societal needs. The underlying conceptualization tied the "colonized" history of pure science to demands for scientific utility, while integrating the larger political rhetorics of the left and the right.

It is no surprise, then, that the semantics of science policy, and the underlying conceptualizations, have traveled far in space and time. Désirée Schauz of the Munich Center for the History of Science and Technology, and one of the workshop's co-organizers, explained that under the Nazi regime an initial distinction was made between Grundlagenforschung (basic research) and Zweckforschung (goal-directed research). This distinction created a space for a degree of autonomy in Germany's state-centered science. She explained that, "The metaphor of 'basic' did the trick: it conveyed that science would lay the foundation for all kinds of future benefits."

After the war, according to Gregor Lax of the University of Bielefeld, West Germany adopted a language highly consistent with that of the linear model: Grundlagenforschung (basic science) and Anwendungsforschung (applied science). According to Manuel Schramm of the Technical University of Chemnitz, Communist East Germany went so far as to institutionalize its research programs explicitly under these concepts (and, I should add, in a framework surprisingly similar to that used by the US Department of Defense). The specific meanings of concepts that were shared far and wide differed according to their local context. However, it is a testament to the power of "basic research" as a political symbol that it could be adapted to science policies of the United States as well as those of East Germany.

Alexei Kojevnikov, from the University of British Columbia, explained that "pure science" had no place in the early Soviet Union, where it was considered to be "a false consciousness of academics in contemporary bourgeois societies." Later, after Sputnik, the Soviet Union also came to recognize a distinction between "basic" and "applied" research. Likewise, Zuoyue Wang of California State Polytechnic University, Pomona, explained that: "For much of the history of the People's Republic of China, debates over basic vs. applied research drove, animated, and sometimes masked the dynamics of its science policy – making and politics." The concept of "fundamental research" did similar work in the UK, according to Sabine Clarke of York University, where colonial development was offered as the justification for significant "fundamental research" investments from the British Treasury.

Incredibly, over the twentieth century, a period characterized by massive global conflicts, the conceptualization of science policy became universalized in important respects and perhaps even as a direct consequence of those conflicts. Over that period, we also saw the transnational community of scientists developing a shared political agenda in pursuit of public support quite apart from the big ideological battles of the times. To be sure, plenty of scientists were caught up in those battles as well. Today, the modern "science lobby" is a globalized community that crosses national borders and has created its own supranational institutions and practices.

Yet, in more recent times, the universalized language of science policy has begun to show weaknesses. Part of this no doubt has to do with the end of the Cold War and part with ever greater government demands for accountability from researchers, straining the old linear model whose claim to describing how the real world works has frequently been shown to be quite limited, although accepted for decades as a "schizophrenia."

Times may be changing. "Innovation," according to Benoît Godin of the University of Montreal, "is a counter-concept to science – and more particularly to basic research" and thus threatens to upset the old order. Tim Flink, WZB Berlin Social Science Center, showed how the European Research Council has sought to redefine "basic research" with the new jargon of "frontier research." Flink argues that such a semantic shift helps to overcome two deficits of legitimacy: one in "basic research," which no longer does the conceptual work it used to do at the boundary of science and the rest of society, and the other regarding a perceived democratic deficit of European governance institutions. He asks if the new notion of "frontier research" might represent a shift in science-policy practice.

Another of the workshop organizers, David Kaldewey of the Forum Internationale Wissenschaft, asked a similar question. He is looking at the "grand challenges" discourse which in a short period has become ubiquitous in science-policy discussions. He asks "whether the grand challenges discourse has the potential to become a science policy master narrative for the 21st century?"

The historical science-policy stories that we tell and the concepts that we use are important to how scientists, politicians, and the public think about science policy today. As Gooday explained: "a particular narrative of past events [serves] to give primacy to certain agents and processes in explaining the historical 'successes' of science; moreover, they extrapolate from these to make political appeals to grant funding to those privileged in their accounts as the key agents of future scientific change."

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References

1. http://en.wikipedia.org/wiki/The_General_Theory_of_Employment,_Interest_and_Money

2. http://www.sciencemag.org/content/156/3783/1699.short

3. http://www.jstor.org/stable/pdfplus/10.1086/667978.pdf

4. http://sciencepolicy.colorado.edu/admin/publication_files/2012.20.pdf

Science Advice to Governments

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Globally, governments have incredible access to expertise. Some of these experts work directly for governments, while others are found in academia, in business, and in civil society. How can governments best tap into this wide array of expertise in making policy?

This important question was the backdrop for the first global conference on science advice to governments, held in Auckland, New Zealand, in August 2014. The conference focused on government science advisory mechanisms, which includes (especially in some Commonwealth nations) a Chief Scientific Advisor whose role is to support a prime minister or departmental chief.

The conference was remarkable for the participation of sitting governmental officials. Chief scientific advisors from the UK, Cuba, India, Australia, Ireland, the European Union, and Malaysia were among the participants. The meeting was hosted by Sir Peter Gluckman, chief scientific advisor to the New Zealand government, along with the International Council for Science. I also attended, and will share below some of my observations from the conference.

The meeting was important for the conversations and the network facilitated by the conference. Governance takes many different forms around the world, but one constant everywhere is the need to integrate expertise with decision making. Comparing and contrasting experiences, what works and what doesn't, can help to make science advisory processes more effective.

For instance, in the United States the President's science advisor is a political appointee who is also accountable to the Congress. This gives the science advisor an explicit role in helping to advance the political agenda of the president. Whether or not the president calls on the science advisor is another matter. In contrast, the UK government's chief scientific advisor is not a political appointee and serves a term appointment that may span multiple governments. Clearly there are strengths and weaknesses to each approach, although they represent different approaches to democratic governance[1].

One point discussed at the conference involved the desirability of having a centralized science advisory mechanism at the highest levels of government. For instance, the UK has a chief scientific advisor, but Germany does not. Yet, the German government has an impressive track record of using science in policy. I often point to the German Federal Institute for Risk Assessment as a good example of an agency that has successfully navigated the choppy waters of scientific advice.

The question about the desirability of a centralized advisory mechanism took on greater meaning at the conference when Anne Glover, CSA for the European Commission, gave a candid and heartfelt speech on her experiences as the first person in that role[2]. Glover explained that a number of environmental NGOs had not only called for her to be fired, but also asked the Commission to scrap the CSA position altogether. Their motivation was apparently their dislike of Glover's views on the science of genetic modification[3]. Glover's position, and indeed that of a European Commission's CSA, hangs in the balance as Jean Claude Juncker assumes the EC presidency in November.

Glover's experiences highlight a common challenge facing scientific advisors and advisory processes – a lack of clarity about their formal role in policy making. The EC CSA is new and working this out; however, other institutions don't have that excuse. Both Dr. Raja Chidambaram, principal scientific advisor to the Government of India, and chairman of the Scientific Advisory Committee to the Cabinet, India, and Sir Mark Walport, government chief scientific advisor in the UK, presented very detailed descriptions of their roles in government. However, having a well-defined role did not prevent Walport from being criticized for his views on bees and pesticides very soon after assuming the position[4].

Walport also provided an overview of a new science advisory body in the UK, called the Science Advisory Group for Emergencies (SAGE), initiated by his predecessor. SAGE focuses on events such as the ash cloud from Iceland's Eyjafjallajökull volcano, which brought air travel to a halt across Europe in 2010. The nature of scientific advice in an emergency is very different from that given in the context of a slowly evolving issue, especially one associated with significant public passions.

Having conversations, building networks, and hearing from practitioners is essential to improving scientific advisory processes. Also necessary is solid empirical research on science advice. To be most useful, such research needs to be focused on the needs of decision makers (whether they are politicians, bureaucrats, or expert advisors) and produced in a timely fashion. As Shelia Jasanoff has written[5], such research may not always sit comfortably with expert advisors or their patrons: "It is time for science advisory systems to recognize that – to stay honest – they too need critics from the communities of research studying how knowledge and action are linked together."

In the *Nature* essay that Gluckman identified as the motivation for the conference, Robert Doubleday and James Wilsdon put out a call[6] for steps required to improve the provision of scientific advice in governments: "There needs to be a more open discussion by policy makers of the trade-offs between independence and influence, and of the weight given to different disciplines and perspectives within the advisory system. Governments should do more to incorporate insight from the growing body of scholarship on science policy and expert advice. There is a need for international networks that enable science advisers from different countries to learn from one another." All of these issues and tensions were on display in New Zealand, underscoring the value of debate, networking, and scholarship for scientific advice.

Of course, the need for a "science of science advice" is hardly new. More than 50 years ago, the British philosopher Stephen Toulmin wrote that "unless decisions about science policy are to be left to be made by *éminences grises*, we shall need a corresponding body of independent informed opinion about the natural history of science … research on the intellectual foundation of science policy."

Thanks to the Auckland conference, we have added another brick to the intellectual foundation of science policy. I am very much looking forward to continuing the conversation and to building the network.

References

1. http://www.csap.cam.ac.uk/media/uploads/files/1/fdsaw.pdf
2. http://www.slideshare.net/SciAdvice14/1000-days-in-the-life-of-a-science-advisor-38529597
3. http://www.theguardian.com/science/political-science/2014/jul/24/science-advisers-coalition-environment-ngo-europe
4. http://www.theguardian.com/science/political-science/2013/apr/30/science-policy1
5. http://www.theguardian.com/science/political-science/2013/apr/08/lessons-science-advice
6. http://www.nature.com/nature/journal/v485/n7398/full/485301a.html

The Future of Science Advice in Europe

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Last month, when the European Space Agency's Rosetta mission orbited comet 67P (Churyumov–Gerasimenko) and deployed its Philae landing module, it was a triumph for collaborative science and technology in the EU. But on the same day, the European Commission (EC) and its newly elected president, Jean-Claude Juncker, announced that it would be getting rid of the office of chief scientific advisor (CSA). That meant that Anne Glover was the first and, for now, the last chief scientific advisor to the president of the EC.

The stark contrast between the technological achievement in space exploration and the bureaucratic wrangling down below did not go unnoticed. James Wilsdon of the University of Sussex observed[1]: "The European Commission chose the evening before the Rosetta landing to confirm quietly that its most senior scientific role, that of chief scientific adviser (CSA) to its president, is being scrapped." Now that the dust has settled a bit, what does the termination of the Commission's CSA signify for the future of science advice in Europe?

Epitaphs written in the aftermath of Juncker's decision to eliminate the CSA often elevated the office to a status that it never had in its short existence under Juan Manuel Barroso. For instance, Sir Paul Nurse, president of the Royal Society commented[2]: "This appears to be a very backward step by the new Commission, having only made the enlightened decision to raise the profile of scientific advice three years ago." Professor Dermot Kelleher, president of the European Academies of Medicine, lamented that the Commission's CSA office "was key in catalyzing scientific advice from across the spectrum, to inform the work of the European Commission in formulating sound policies for Europe."[3]

The reality of Anne Glover's role in the Commission over the past three years was far more prosaic than these comments would suggest. Last August, at a conference in Auckland on global scientific advice organized by Sir Peter Gluckman, chief scientist to the New Zealand government, Glover gave a candid and revealing talk on her experiences as the Commission's CSA. It was a remarkable talk, as I noted at the time. Slides from her talk, "1000 Days in the Life of a Science Advisor," have been downloaded more than 6,000 times[4].

In the talk, Glover explained that the CSA office had minimal resources (a staff of two when she began), and she occupied the role for 51 days before her first face-to-face meeting with President Barosso. Six months into the job, she started sharing briefings from her office with other EC departments, a favor that she says was not returned. Glover further noted that she asked Commission departments to nominate a "correspondent" to facilitate interaction with the CSA office, only to be ignored and, in at least one case, simply rejected. As Professor Albero Alemanno notes[5]: "She quickly found herself in an institutional vacuum." Glover's story goes on, and it doesn't get much better. Ultimately, President Barosso felt compelled to distance himself publicly from Glover and the CSA office over issues related to genetic technologies in agriculture.

In short, the CSA under President Barosso was largely powerless and disconnected. This state of affairs was not the fault of Glover, who took on the CSA role with energy and enthusiasm. The uncomfortable reality is that establishment of the CSA office was a symbolic gesture towards scientific advice, rather than representing any substantive commitment to improving science advice in Europe[6].

From this perspective, President Juncker has actually done the scientific community a favor. For the past three years, most scientific organizations and their leaders seemed perfectly content with a symbolic, ineffectual CSA in the Commission. However, the termination of the office has forced a conversation that probably should have been occurring in far more prominent settings. Such a conversation is now underway (see, e.g., this special issue of the *European Journal of Risk Regulation*[7]) and should continue.

President Juncker has yet to release details on how his administration is to structure advisory mechanisms, noting through a spokesperson[8]: "President Juncker believes in independent scientific advice. He has not yet decided how to institutionalize this independent scientific advice." However the Commission eventually structures its offices, a few issues will no doubt continue to be at the center of debates over science advice in Europe. Here I suggest several:

Separate Science Advice from Single Issue Advocacy

Last summer the position of the Commission CSA became the subject of debate[9] when a number of environmental NGOs called for Glover to be sacked and the office abolished. Their concern was apparently over Glover's views on technologies of genetic modification[10]. The knee-jerk response of many single-issue campaigners is to attack the advisory process when it results in scientific judgments that they find politically inconvenient.

Such calls should be countered because, if successful, they would mean a complete loss of science advisory capabilities. In highly politicized contexts, any scientific conclusion is going to make some vested interest unhappy. Advisory processes should be improved when viewed to be unsatisfactory, not eliminated. To the credit of these NGOs, after their first, ill-advised campaign to eliminate the Commission's CSA, they have focused their attention in more constructive directions such as in this discussion of the principles of effective scientific advice.

Focus on Scientific Advice, not Particular Institutional Forms

The CSA is only one of many possible configurations for the provision of scientific advice. In Europe, the CSA has its origins in the British system. Other governments, notably Germany, have an excellent record of providing scientific advice in government without using a CSA model. What matters for effective decision making is the integrity and utility of advisory processes, not a particular institutional configuration.

The United States has adopted a hybrid model[11]. It has a chief scientific advisor to the President, whose role and office is largely symbolic except for its role in the budgetary process. The heavy lifting associated with providing scientific advice to Congress and the federal agencies occurs in myriad committees and agencies, typically relying on academic, industry, and civil society expertise.

The European Commission (and the EU more broadly) could adopt any of these models, or something different still. The Commission may or may not need a CSA, but it does need a more thoughtful approach to scientific advice. At present, there is a need for conversation about what role science advice is to have in decision making, and alternative structures that might be implemented to deliver that advice effectively. Of course, in the diverse EU, national and cultural perspectives on governance and advice will have to be openly considered in any such conversation, recognizing that what works in one or more nations may not necessarily be appropriate for Europe as a whole.

Scientific Bodies Should Lead the Discussion

It is probably unrealistic for a conversation about alternative approaches to scientific advice to come from the European Commission itself or from individual national governments, as these bodies will be too close to the politics of advice. I am also skeptical that academics or representatives of NGOs are well prepared to lead such a discussion. Such individuals are often too easily distracted by single-issue advocacy on topics such as genetic technologies, climate change, pesticides, or nuclear power. However, individuals from governments, academia, and civil society should be included in any such discussion.

Leadership should come from professional scientific societies, including national science academies. By organizing a high-profile discussion of architectures for the future of science advice in Europe, such bodies might assume the role of an "honest broker" helping to clarify or even expand alternative ways forward. They can also help to play a role that they mostly ignored over the past three years. The termination of the Commission's CSA represents an important opportunity for the scientific community. We should take it.

References

1. http://www.theguardian.com/science/political-science/2014/nov/13/juncker-axes-europes-chief-scientific-adviser
2. http://www.sciencemediacentre.org/expert-reaction-to-news-about-abolition-of-post-of-csa-to-european-commission/
3. http://www.sciencemediacentre.org/expert-reaction-to-news-about-abolition-of-post-of-csa-to-european-commission/
4. http://www.slideshare.net/SciAdvice14/1000-days-in-the-life-of-a-science-advisor-38529597
5. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2515738
6. See paper for background: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2515738
7. http://ejrr.lexxion.eu/issue/EJRR/2014/3
8. http://www.euractiv.com/sections/innovation-enterprise/juncker-still-mulling-scientific-advice-role-309999
9. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2515738
10. http://www.theguardian.com/science/political-science/2014/jul/24/science-advisers-coalition-environment-ngo-europe
11. http://www.springer.com/philosophy/history+of+science/book/978-90-481-3897-5

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