Linking Science to Societal Benefits: Why, How and When?

INTERNATIONAL WORKSHOP AT THE CENTRE FOR CLIMATE SCIENCE AND POLICY RESEARCH

LINKÖPING UNIVERSITY

14-17 SEPTEMBER 2009

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LINKING SCIENCE TO SOCIETAL BENEFITS: WHY, WHEN AND HOW?

AGENDA

MONDAY 14 SEPTEMBER

17.30	Meet in Elite Grand Hotel lobby to walk to CSPR
18.00	Welcome reception at the Centre for Climate Science and Policy Research
	VENUE: CSPR, 7th floor Kåkenhus, Campus Norrköping

TUESDAY 15 SEPTEMBER

	Venue: K8A, 8th floor Kåkenhus, Campus Norrrköping
9.00-9.15	Welcome address Björn-Ola Linnér, Director of the Centre for Climate Science and Policy Research, Linköping University
9.15-9.45	Presentation of workshop aim and theme Roger Pielke Jr, University of Colorado & Eva Lövbrand, Linköping University
9.45-10.15	Coffee and Tea
10.15-12.00	**THEME I: WHY SHOULD SCIENCE BE LINKED TO SOCIETAL BENEFITS?** Presentations by: Lisa Dilling, Silke Beck, Mark Howden, Netra Chhetri, Erik Glaas Chair: Björn-Ola Linnér (10-15 minutes per participant followed by chaired discussion)
12.00-13.30	Lunch
13.30-15.30	**THEME II: WHAT DO WE MEAN BY SOCIETAL BENEFITS?** Presentations by: David Demerrit, Mark Neff, Mathias Friman, Benjamin Hale, Magdalena Kuchler Chair: Steve Rayner (10-15 min per participant followed by chaired discussion)
15.30-16.00	Coffee and Tea
16.00-16.30	Sum up reflections and practical info Roger Pielke Jr & Eva Lövbrand
16.45-17.45	City tour of the old industrial landscape in Norrköping
19.00	Workshop Dinner

WEDNESDAY 16 SEPTEMBER

Venue: K8A, 8th floor Kåkenhus, Campus Norrrköping

9.00-11.00 **THEME III: WHEN AND HOW SHOULD SCIENCE BE LINKED TO SOCIETAL BENEFITS?**

Presentations by: Reinar Grundmann, Mark Brown, Victoria Wibeck, Anna Jonsson, Björn-Ola Linnér

Chair: Roger Pielke Jr

(10-15 minutes per participant followed by chaired discussion)

11.00-11.30 Coffee and Tea

11.30-12.30 **WHAT CAN WE LEARN FROM PAST RESEARCH AND WHAT NEW RESEARCH IS NEEDED IN THIS FIELD?**

Break-out groups A, B, C

12.30-13.30 Lunch

13.30-14.30 **Reports from break-out groups**

Presentations by participants followed by chaired discussion

14.30-16.00 **Plenary discussion: How do we move on from here?**

Moderator: Roger Pielke Jr. and Eva Lövbrand

THURSDAY 17 SEPTEMBER

Venue: K4, Entrance floor. Kåkenhus, Campus Norrköping

10.15-12.00 **LINKING SCIENCE TO SOCIETAL BENEFITS: WHY, WHEN AND HOW? PANEL DISCUSSION OPEN TO UNIVERSITY STAFF AND STUDENTS**

Panel participants:

- **Uno Svedin, Formas**
- **Silke Beck, UFZ/ Leipzig**
- **Benjamin Hale, CSPTR/ University of Colorado**
- **Reiner Grundmann, Aston University**
- **Chairs: Eva Lövbrand, CSPR/LiU & Roger Pielke Jr., CSPTR/University of Colorado**

12.30-13.30 Lunch

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WORKSHOP COMMENTS

by Silke Beck

Department of Economics

Helmholtz Centre for Environmental Research - UFZ

WHY SHOULD SCIENCE BE LINKED TO SOCIETAL BENEFITS?

In my view, the democratic justification is the most powerful one since it is embedded into the declarations of human rights, rule of the law and the promise of modern mass democracies (Habermas, Weingart; Ezrahi; Fischer).

It holds that

> expertise, as form of delegated power, should be held to norms of transparency and deliberative adequacy that are central to democratic governance.

Attempts to alter the range of expertise and thus the growing salience and reliance of knowledge on decision-making should be "bound" by democratic control. Expertise cannot be insulated from, but has to be complemented by critical scrutiny and democratic accountability. Expert bodies – at the interface between science and policy - thus face the challenge to reconcile ***democratic values*** with the need for ***expert decision-making***.

The major analytical challenge is to combine **reflexive concepts of knowledge production with procedural concepts of deliberation.**

1. While many theories of democracy recognize the contribution of expertise to deliberation and democratic decision-making, these frameworks rarely if ever incorporate the increasing depth of social science understanding of the production of knowledge and scientific advice. According to STS scholars, the exploration of deeper commitments, assumptions, and power relationships of any given epistemological framework and their impact upon policy has to be at the core of any serious attempt to open science to democratic deliberation and decision-making.

2. There are many arguments for expert democratization, but perhaps the main one concerns the issue of the added ***procedural*** justice and legitimacy of any decision, thus creating active trust and credibility. I would argue there is a need to detach concepts of deliberation from the philosophical legacy and to abandon the **prescriptive** ambition altogether.

Deliberation is often seen as a problem-solving strategy that will improve the quality, thus the effectiveness of policy outcomes, particularly for complex problems involving uncertainties and conflicting values (Funtowicz & Ravetz 1993). Both approaches challenge the notion that deliberation will necessarily improve the quality and problem-solving capacity and thereby warranting "better" substantive outcomes. This idea is empirically false and politically risky. It assumes a

- ➜ causal relationship between the outcome (impact) and process/ procedures (cause).

An alternative approach requires the turn from

- ➜ outcome to process orientation,
- ➜ substantial to procedural criteria,
- ➜ a prescriptive to an empirical and reflexive approach.

Such an approach does, however, require that scholars are ready to open up their theoretical commitments to empirical contestation.

Open questions are:

- ➜ how can calls for expert democratization linked to deliberative democrats' account of legitimacy?
- ➜ **The empirical test requires criteria to assess the experiment:** There is a need for specifying and adhering to internally consistent criteria of legitimacy to make a convincing case for more deliberative governance of science and technology.

Calls for expert democratization often imply that scientific priorities and methodological choices should be open to wider debate.

Different empirical studies show that if "users" and potential "audiences" – those who may be directly or indirectly affected by research – have been involved from the beginning into the set up and design of research science, it had contributed to the relevance, "ownership" and the acceptance of scientific results (Epstein's aids activists, for instance).

The answer to this question, however, seems to be very dependent on the questions and issue at stake (the degree of complexity, linearity, certainty) and the political and social context, and it can be only assessed by case by case.

The problem also reflects a structural problem that is also discussed as "trans-science" problem and it refers not only to the time frame, but also to the scope, scale and level of different institutional spheres. If science and politics are seen as distinct systems or relatively autonomous realms that follow different criteria, rationalities and logics (and time frames...), the problem arises how to couple/ combine or integrate them in an efficient and effective way. While the policy cycle prefers short-term time spans, scientists usually prefer long-term horizons.

This problem highlights the need for:

- ➜ boundary organizations or hybrid negotiations in order to translate and bridge between these different expectations, to translate information needs into research questions .... to adapt different time frames
- ➜ mechanisms and procedures to reconcile the "demand" and "supply" to foster the mutual understanding of limits of knowledge production and of the political implementation or their different time frames
- ➜ tools and instruments how to deal with problems of science to deliver expected scientific results "in time" and to cope with existing uncertainties and ambiguities ...
- ➜ mechanisms and procedures how to assess the "usefulness" and "political relevance" of research
- ➜ structural constraints and resistance to adapt/ transform science according to new, external expectations.

WHAT IS THE BEST WAY TO LINK SCIENCE TO SOCIETAL BENEFITS?

Naively embracing more participation, of whatever kind, is definitely not a solution. Given widely diverging understandings of public engagement, it is imperative not simply to call for more societal participation in science and science policy.

Following approaches in risk management, it is not a question of inclusion/ extension but of recursive coupling scientific analysis/ expert appraisals and deliberative procedures.

The significant question than is how scientific analysis/ expert appraisals and deliberative can be linked in a useful way and take place in an integrated fashion, making room for lay as well as expert input that could also offer guidelines for how to proceed.

One of the lessons learnt from our cases is that a one-size-fits-all model cannot work because the most appropriate ways to achieve the principles can vary from case to case.

- Expertise and procedures of appraisal relevant to public decisions responds to specific institutional imperatives that vary within and between nation states.
- The current understanding of public deliberations is insufficient to forecast support in general or for specific themes, and cannot obviate a thorough investigation and engagement for each case. Thus, it is important to assess the context in which the initiative is underway.

Again, there is a growing need for criteria:

- Reciprocity, transparency, publicity and accountability emerge as important procedural criteria for such deliberative excercies
- Need to distinguish between deliberative from non-deliberative forms of public engagement in the politics of science
- some forms of public engagement are far less top-down --and perhaps enjoy more "positive" or "empirical" public legitimacy -- than others

From a simplistic actor-centered and "reflexive, contextualized" advocacy of deliberation

- A documented mismatch between theory and practice may not simply mean that practice has not lived up to the theoretical ideals.
- Dilemma of democratic institutions is to generate the same public attitudes upon which they rely.
- Since deliberation is supposed to transform citizen preferences (including preferences about politics), it does not contradict calls for deliberation to say that current public preferences oppose deliberation (M. Brown)
- The next step towards a normative theory of expertise is to look into the (emerging and/or designed) arrangements that are conducive to deliberation and robust outcomes.

rather than considering deliberations in abstract isolation:

- it is necessary to examine them in their context, such as the wider context of governance and the actual organization of deliberative debates in each case
- Embeddedness: constraining and enabling role of institutional frameworks and their impact upon policy

Institutional frameworks have to be carefully reviewed.

The main issues are, first, that enhancing accountability through deliberation will need to be accompanied by a re-examination of the institutional constraints.

Second, it is critical that agencies continue to cope with the issue of how to adequately involve and represent the knowledge, views and values of a diverse public and how to enforce institutional adjustments to effectively integrate solutions into existing regulatory structures.

Thus, there is a growing need to explain the features of the institutional arrangement that contribute to constrain and enable the knowledge production and deliberation making processes.

Hence, rather than interpreting institutional failures as distortions from the theoretical ideal, engagement with practice would draw attention to possible tensions in the ideal itself. To open up the theory of democratic expertise to the concerns and perspectives of those who design and participate in real-life citizen-science deliberations would, from this vantage point, not only be a matter of principle and consistency. It would also help scholars of science and technology to address matters of institutional design and hereby move the theoretical debate into a more operational mode.

WORKSHOP COMMENTS

by Mark Brown

California State University, Sacramento

The workshop description asks participants to consider the relationship between science and societal benefits, as well as the role of public engagement in that relationship. Nowadays it seems to be widely assumed—to the dismay of some scientists—that all scientific research should provide some sort of societal benefit. In many areas of contemporary science, commercialization pressures foster a rather narrow view of societal benefits, focused on marketable consumer products. A somewhat broader conception, typically associated with climate science and other areas of policy-relevant science, appears in the notion that science should aim for understanding and solving societal problems. Historically, advocates of modern science have often offered an even broader view of how science benefits society: all science—even science conducted "for its own sake"—embodies and promotes various desirable cultural values, such as reasonableness, community, impartiality, etc. Regardless of which view of societal benefits seems most relevant in any given context, people often disagree on whether science is actually generating the benefits in question. One way of attempting to resolve such disagreements has been to promote various forms of public engagement. But despite many years of public engagement efforts, their potential and limits remain poorly understood, hence the workshop questions: "why, how, and when?"

WHY? The workshop abstract notes that advocates of public engagement in science policy have offered many different justifications, leading to a certain lack of clarity about why public engagement may be justified. It seems that the most common justifications draw on some combination of two basic ideals: political legitimacy and scientific progress. Justifications for public engagement based on political legitimacy adopt some version of the ancient Roman legal principle of "What touches all should be considered and approved by all." For example, it is often said that taxpayers whose money funds scientific research have a right to influence how their money is spent. With regard to climate change, one might argue that because climate change affects every person on the planet, climate policy should be "considered and approved" by everyone everywhere. (That's a rather larger group of constituents than the "users" of climate science mentioned in the workshop description.) This sort of justification obviously creates an impossibly high standard for public engagement, but it may be useful in shifting the burden of proof: from this perspective, what needs to be justified is not public engagement but public exclusion. There are probably many good reasons to include some of those affected by climate policy from some of the processes through which it is created and implemented—lack of interest, time, knowledge, etc.—but all such exclusions should be justified with reference to the interests of the excluded. How to assess such interests, of course, raises a host of difficult questions, not least of which is how to involve people in assessing their own interests.

A different justification for public engagement is sometimes made with reference to its alleged epistemic value. For example, it is often said that public engagement promises to identify blind spots in existing scientific methods. This argument has often played a role in biomedical research, where researchers may not be fully aware of patients' needs and experiences. With regard to climate science, to the extent that climate science bodies such as the IPCC incorporate biases particular to industrial countries (who provide the majority of their members), increasing participation by scientists from LDCs may improve the epistemic quality of the research.

WHEN? Given that justifications for public engagement are diverse and often ambiguous, one also needs to consider the time frames within which it makes sense to link science to societal benefits. One frequent but not especially helpful recommendation is that public engagement should not occur too early, or else the problems won't be understood and the stakes won't be clear, but also not too late, or else the range of options will be too narrow. A more general concern in this regard is the frequent disjunction between the short time horizons common in politics and the very long and/or unpredictable time horizon of much scientific research. Public engagement efforts need to recognize that many scientific research projects simply take a long time, or they risk making unrealistic demands for short term societal benefits. But scientists also need to recognize that the short time horizon of political processes is not always a sign of superficiality or corruption. From the perspective of democratic institutions, there are often justifiable pressures to make a decision and act—elections are coming up, a coalition is falling apart, etc.—regardless of the amount or quality of available knowledge. The dominant approach to climate policy—especially the focus on long-term targets for emissions reductions—might be seen as the imposition of a scientific conception of time onto politics.

HOW? The workshop abstract rightly notes that empirical studies suggest that efforts to generate public engagement in science policy often face great practical difficulties. The abstract mentions two key questions in this regard: what institutional designs are most effective? and which groups should be involved? I think public engagement efforts should embrace a wide variety of institutional forms, and they should avoid becoming fixated on fashionable devices such as consensus conferences or citizen juries (as useful as those sometimes are). The politics of climate policy has already been shaped by everything from public protests and demonstrations to interest group lobbying to consumer surveys to citizen advisory panels. Although the proliferation of modes of engagement may seem rather chaotic, and although it fails to produce a single coherent message, it helps ensure that those excluded from one mode of engagement will be able to express their views somewhere else. Moreover, the lack of a coherent message is not necessarily a problem, if one avoids the common image of democracy as dependent upon a unified public will. Representatives of various kinds—including those associated with the international institutions involved in climate policy—need not attempt to echo a unified public will (which doesn't exist anyway). Rather, they need to consider the various modes of public engagement and produce publicly justified, publicly accountable responses. In this respect, research on public engagement in climate policy needs to devote more attention to how international institutions can best fulfill their task of representing the global public sphere.

As for which groups should be involved, the answer depends on the justification for involvement. If we adopt the very broad justification mentioned previously, then as many groups as possible should be "involved," albeit in different ways. Within the current politics of climate policy, it seems especially important to generate greater involved from LDCs. Doing that of course requires going beyond the creation of institutional structures; it depends on ensuring that those asked to participate have the financial and educational resources to do so. It also depends on creating institutions that strive to recognize cultural diversity and conflicts of interest without precluding the possibility of agreement and solidarity. In this respect, the ancient tradition of cosmopolitanism, which has been receiving increased attention in recent years, may offer important resources for the popular politics of climate policy.

WORKSHOP COMMENTS

by Netra Chhetri

Consortium for Science, Policy & Outcomes

Arizona State University

In recent year, spurred by the controversies over GM food, nanotechnology, and the politics of climate change, there has been an increasing effort to increase interface between science and society. Some of the classic activities include citizen consultations, citizens' juries, public deliberation, science café, and participatory appraisal. But these efforts have not yet proved sufficient. The debates about the role of science in society have often focused on institutionally-orchestrated forms of participation and have inadequate to connect with the cultures, values, complex structure of society and practices, and systems of science itself. So it may be worth discussing - how will new relationships between science and society change the conduct of science?

A recent experience of scientists (engineers) and their students from Arizona State University (ASU) is worth sharing. A group of engineering faculty and students spent about a year to developed two technological fixes for a remote village in Ghana – cook stove that operates on smokeless gelled ethanol and ***twig light*** a thermoelectric generator using twigs to light a bank of LED lights enough for a small room. Not sure whether the technological fixes really address village problems, the group was keen to know if any one of the two will be embraced by the villagers.

According to the group, the stove was significantly more efficient than the one recently developed in South Africa and the gelled ethanol was about five times cheaper than other alternatives marketed in the Capital of Ghana. The group was very proud of their innovation and believed that the technology will work for the benefit of society in Ghana. After a field test this summer the group learned that their stove had several design flaws including the sturdiness to hold the big pot. Also the cost of gelled fuel, too, was high, as villagers get their firewood from their own farm for free. Through a simple village mapping, an embedded social scientist in the group also found that a typical family had a family size of 10-21, a far cry from the small family the group expected, hence the design. Contrary to the popular belief, smoke was considered a part of daily life and not a problem to their health.

The gelled fuel cook stove marketed to address the problem of deforestation and health issues in Ghana (across the world for that matter) were indifferently dismissed by the villagers. For them firewood was free and easily accessible from their farm plots. Smoke was part of daily cooking which they did not perceive to be a health problem. Adopting the improved stoves would mean changing their lifestyle, habits, values and interests. So they were not ready to fix a problem they felt did not exist for them.

The story of twig light was different. It was made from a low cost. A simple lighting device built as a low cost alternate light source for poor villagers. When it was demonstrated for the first time, villagers suggested using some burning embers/charcoals from the fireplace instead of twigs and voilá – the LED lights lit up bright enough to read a book in a dark room. Another exciting part of twig light was that villagers immediately asked whether it could also be modified to recharge cell phones? Obviously science has different meaning and value when societies see its benefit. But in an era when the overlap between science, governments, and industries growing; there is a strong need for science to be relevant for society.

For the villagers, the twig light solved a problem costly, unreliable, centrally controlled electric service. As we know fundamental basic services such as electricity, health, and education in developing regions are notoriously dysfunctional. The twig light to light he home is clearly a felt need that has met with success in improving people's quality of life. Unlike cook stove, twig light did not force them alter their way of life and allowed them to keep their values, interests, and habits.

Science (or scientists) needs to find ways of listening to and valuing more diverse forms of public knowledge and social intelligence. It is important for scientists to also discuss the risks as well as the potential benefits of science (new knowledge) in the early stage of development. By being open and honest to the public scientists cultivate the respect and trust of society, and restore it where it has been damaged. Only by opening up innovation processes at an early stage scientist can ensure that science contributes to the common good.

A different but most challenging global problem is the issue of climate change. In the upcoming UN climate summit (COP15), to be held in December 2009, global community is trying to reach a binding climate agreement that will apply to the period after 2012 when Kyoto Protocol expires. If agreed, the decisions made at COP15 will likely shape the global climate policy for years to come. As part of this process, decision-makers will be provided with pertinent scientific, technical and economic analysis, and the views of organized stakeholder groups (notably industry representatives and environmentalists). Ironically, citizens of the world, who will have to live with this future climate policy, are at the periphery of this important negotiation. Isn't it important to know the views from society who are not active in stakeholder groups? Isn't it makes sense to discuss the problem of climate change with people to whom it is going to affect?

The enterprises of science, in its current form, lacks human and social dimensions as the public are reduced to the role of a hapless bystander. We devote far too little intellectual resources towards outcomes of science in the society. The institutional infrastructures to increase the interface between science and society are developed far less than the institutions of the conduct of sciences. The outcomes of scientific innovations are rarely considered in the pursuit of science. Our scientific infrastructure and the bureaucracy that is in place significantly outweigh our understanding of society, which is very complex and diverse. So I am not sure if there is one universal method that can be subscribed as panacea for linking science to social benefit.

HARNESSING SCIENCE AND SECURING SOCIETAL BENEFITS: REFLECTIONS ON UK SCIENCE POLICY

by David Demeritt

King's College London

Department of Geography

In this brief paper, I'd like to address the three overarching questions of this workshop—about why, when, and how science should be linked to societal benefits—by reflecting on recent efforts by UK science policy makers to increase the economic and other impacts of UK science.

In January 2009, the UK Research Councils announced that they would henceforth require all applicants for research funding to provide 'impact summaries' to explain who would benefit and how from the proposed research and set out plans for ensuring those benefits are realized. The new policy is direct response to a recommendation of the Warry Report (2006) on ***Increasing the Economic Impacts of Research Councils***, commissioned by the UK Government's Department for Trade and Industry. Although societal impact is not an explicit criterion for peer review of Research Council funding applications, as it has long been with the US National Science Foundation, the new requirement has, nevertheless, prompted some strong criticism from the UK science and research community. A group of 20 eminent scientists signed a letter of protest, published in the influential ***Times Higher Education***, complaining about these and other bureaucratic burdens and the threats they pose to basic research and to British scientific excellence (Braben et al 2009; Corbyn 2009). In part, the backlash simply reflects the vested interests of those concerned their funding may be cut, but it also underscores a series of wider concerns about the drift of recent UK science policy. While the dissolution, in the June 2009 cabinet reshuffle, of the Department for Innovation, Universities, and Science and its merger with the influential Department for Business, Enterprise & Regulatory Reform (BERR) was mostly about increasing Peter Mandelson's ministerial portfolio to reward him for saving Gordon Brown's premiership from backbench rebellion, for many the acronym for Mandelson's newly created Department for Business, Innovation & Skills says it all: BIS.

Science delivers many things (and pinning down just what we might mean by its 'societal benefits' should probably be the first task for the workshop), but over the last decade successive Labour governments have repeatedly emphasized its centrality to economic growth and competitiveness in a new knowledge based economy (e.g. Secretary of State for Trade and Industry 1998; 2000; DTI 2003; DIUS 2008a). Although the UK boasts an excellent track record of basic research, ranking second only to the United States on many measures of scientific productivity, its success in applying that science and in translating research strength into commercial application and jobs has been nowhere near as good. Accordingly, increasing the impacts of UK science and accelerating technological innovation, economic productivity, and commercial application have been abiding obsessions of the Blair and Brown governments and their strategies for transforming the UK into an ***Innovation Nation*** (DIUS 2008b). Those concerns lay behind a Ten Year ***Science and Innovation Investment Framework 2004-2014*** (HM Treasury 2004) to guide very substantial increases in public funding aimed at both developing the nation's science base and harnessing it to serve the interests of wealth creation:

> Harnessing innovation in Britain is key to improving the country's future wealth creation prospects. For the UK economy to succeed in generating growth through productivity and employment in the coming decade, it must invest more strongly than in the past in its knowledge base, and translate this knowledge more effectively into business and public service innovation. The Government's ambition, shared with its partners in the private and not-for-profit sectors, is for the UK to be a key knowledge hub in the global economy, with a reputation not only for outstanding scientific and technological discovery, but also as a

> world leader in turning that knowledge into new products and services (HM Treasury 2004: 1.1)

This metaphor of putting science into the harness to drive economic competitiveness is a recurrent trope of UK science policy (cf. HM Treasury 2002: 5.34; RCUK 2007; Scottish Executive 2001). It first figured in the opening paragraphs of the last Conservative government's white paper on science policy, ***Realising Our Potential***, which also resulted in the insertion of a commitment to contributing to the "economic competiveness" of the UK into the Royal Charters of all UK Research Councils:

> steps should be taken which, on the basis of other countries' experience, will help ***harness*** strength in science and engineering to the creation of wealth in the United Kingdom by bringing it into closer and more systematic contact with those responsible for industrial and commercial decisions (HMSO 1993: 4)

The image here is of science as a wayward horse that must be bridled and actively steered to keep it on course and pulling in the right direction. To that end, policy reforms have sought to improve the mechanisms for harnessing science to the twin goals of wealth creation and economic competitiveness, such as increasing university-business collaboration (Lambert 2003) and providing clearer institutional incentives for university researchers to engage in applied research and other "enterprise activity" (Roberts 2003: para 72). Where New Labour science policy has differed from that set out by the Conservatives in the 1990s is not in the economic returns it sought from science or the strong steer it has sought to provide so as to make UK science more "business-led and focused on commercially-oriented R&D" (Roberts 2002: recommendation 6.7), but in its recognition that science needs feeding as well as steering if it is to deliver economic rewards for the nation. As well as redressing years of under-investment in a crumbling research infrastructure, recent UK science policy has sought to address long term shortages of skilled scientific labour (Roberts 2002) and public ambivalence about biotechnology and other cutting edge research(DIUS 2008b), which has "negatively affected the UK competitive position" (DIUS 2008a: 92).

Britain is hardly alone in this desire to reap economic rewards from science and scientific research. Singapore and other Asian tiger economies see science as key to securing their place in the global knowledge economy (Holden and Demeritt 2008). Likewise, science also plays a central role in the strategies of the Lisbon agenda to make the EU the "most dynamic and competitive knowledge-based economy in the world" (European Parliament 2000). Although EU rhetoric about sustainability and the European social model potentially opens up a range of different ways in which science might figure in the future of Europe, economic imperatives provide the central organizing lens for recent EU science policy discussions, concerns about the democratic deficit in EU governance notwithstanding. This overarching economic framing transforms social exclusion and unemployment into problems of low human capital, to be addressed through "increased participation in mathematics, science, technology, and engingeering studies" (3.4.1), while sustainability and eco-innovation are repositioned as strategies for "[t]aking the lead internationally" and securing "a first-mover advantage, which can be long-lasting …[if it] enables Europe to set international standards" (European Commission 2005: 25, 23).

With the recent global downturn, these calls to harness science for economic growth have become increasingly urgent, both in the UK and internationally. Seeing science as one of the ways of 'Attacking the Recession' (Leadbeater and Meadway 2008; Drayson 2008), the new Science Minister Lord Drayson (2009) has repeatedly suggested that "the time has come for the UK—as part of a clear economic strategy—to make choices about the balance of investment in science and innovation to favour those areas in which the UK has clear competitive advantage." As I'll discuss in a few moments, there is some ambiguity both about what exactly is meant by "areas in which the UK has a clear competitive advantage" (are these areas where UK science is particularly strong, such as earth systems science or British history? Or are they areas where British industry is leading, such as financial services, pharmeceuticals, and film production?) and consequently about the policy implications of shifting the balance of investment in science to favor them (whose investment? How can it be shifted? What would be favorable?).

Despite these implementation ambiguities, the commitment of the UK government to "developing [science] as a key element of our path to recovery" was underlined in the Prime Minister's recent Romane Lecture to Oxford University. Pledging to promote science and protect future funding as crucial to economic recovery, Gordon Brown explained:

> [t]he economic role of science will be of even more importance than before… Some say that now is not the time to invest, but the bottom line is that the downturn is no time to slow down our investment in science. We will not allow science to become a victim of the recession, but rather focus on developing it as a key element of our path to recovery (Brown 2009)

As these comments should make clear, UK science policy is now largely an extension of economic and industrial policy. The government's recent science and society consultations (DIUS 2008b), for example, were largely silent on questions of scientific governance and on the historically influential role of science as a model for open inquiry in a democratic public sphere (Ezrahi 1990; Rorty 1991). Instead its primary concern was how to overcome the nation's dual deficits of public trust and of skilled scientific workers said to impede "the successful exploitation of science and technology" on which "[o]ur future economic prosperity and our ability to become an Innovation Nation [now] depends" (DIUS 2008b: 1.1).

UK Ministers do occasionally nod at the fundamental role of science in a civilized society. Explaining £500m invested by the UK to support construction of the Large Hadron Collider at CERN, the former Universities secretary commented:

> We should spend money on this sort of thing because we are interested in answers to those questions…It is part of what makes us human beings. We would be a much sadder, poorer world if we did not want to know the answers to these questions (quoted in Corbyn 2008)

Likewise, his successor David Lammy (2009) recently praised arts and humanities research as "an indispensable component of the glue that holds the country together and without which we cannot truly flourish."

For the most part, however, the societal benefits of scientific and other research are understood in a narrowly economic register. Even as he praised a recent report from the AHRC (2009) on the ***Economic Impact of UK Arts and Humanities Research*** for highlighting how humanities research "encompass[es] those things that make life worth living", Lammy (2009) flagged up its instrumental value in making the UK more attractive to tourists and inward investment. If anything this economic theme was emphasized even more strongly in the AHRC report itself. It noted that economic importance for the UK of the cultural and creative industries and that "value of non-UK undergraduate and postgraduates attracted here to undertake arts and humanities degrees lies in the range of £2.05 to £3.29 billion", an excellent return on the £354m provided by the AHRC and Higher Education Funding Councils to support arts and humanities research in 2008-09 (AHRC 2009: 11, 27). This relentlessly instrumental and economic tone should not be surprising. After all, the AHRC was the only UK Research Council[1] to receive a real term funding cut in the 2007 Comprehensive Spending Review (House of Commons, 2008: para 111). Thus it is hardly any wonder that as the AHRC gears up for the most brutal public spending round in living memory that it has chosen to emphasize its contributions to economic competitiveness rather than its more intangible ones to culture and quality of life, which feature no less prominently in the founding aims of its Royal Charter (AHRC 2004).

Whatever science and higher education ministers may intone about the intangible benefits of science and scientific research, with future public funding under unprecedented pressure, the

1. There are currently 6 other UK Research Councils in addition to the AHRC: Biotechnology and Biological Sciences Research Council (BBSRC); Economic and Social Research Research Council (ESRC); Engineering and Physical Science Research Council (EPSRC); Medical Research Council (MRC); Natural Environment Research Council (NERC); Science & Technology Facilities Council (STFC).

arms-length Research and Funding Councils responsible for delivering UK science policy are almost certain to play it safe and to make the economic values of scientific research central to their future bids for public funding. All that matters with the Treasury is the economic bottom line. The Treasury sees its role in promoting science and research as addressing market failure and the tendency both for the funding and the organization of research to be 'suboptimal':

> There are thus clear rationales for well targeted Government intervention to counteract the tendency for sub-optimal interactions between business and the research base and for business itself to undertake too little research. The main purpose of Government interventions to assist universities and the public sector in improving relations with, and relevance to, the private sector … has been to generate new capacity for commercially focused innovation (HM Treasury, 2002: para 5.17)

Despite its wider public benefits, science is more typically rationalized in UK policy discourse as a public good in the narrowly technical sense. This was the terminology used by the then higher education minister to justify the emphasis to be given to research impacts in the new Research Excellence Framework to be used by the Higher Education Funding Councils to allocate research block grant funding to UK universities:

> It has been suggested recently that researchers should refuse in principle to name any short-, medium- or long-term relevance to their research even if it can be identified. But it can't be right or reasonable to expect billions of pounds of public funding and then systematically deny the taxpayer any insight into its potential applications to the economy, public policy or popular understanding. It is the duty of scientists and engineers in receipt of this public support to ensure that the taxpayer is aware how this investment may benefit him or her (Denhham 2009)

Of course publicly funded science is not the only science there is, though in the UK, private sector investment in R&D is disappointingly low compared to other OECD countries (Lambert 2003), and consequently debates about state funding and steering of science assume greater importance than in countries with a more diverse science funding ecosystem. The danger is that the wider, if often intangible and difficult to quantify, societal benefits from science will be forgotten, or even diminished, in the rush to harness UK science in what ministers now understand as a "race to the top" in the increasingly global knowledge-based economy (Sainsbury 2007).

The recent clamor over the research impact statements only partly reflects these fundamental concerns that 'impact' has been too narrowly defined as ***economic*** impact alone. There are also series questions about how exactly policies to increase the impact of UK research are to be implemented.

Critics have raised three distinct complaints. First, some critics fear that short-term commercial pressures, either to generate research spin-outs or be relevant to ministerial whim (Demeritt 2000), will compromise academic freedom or even lead to the death of the university as a place of critical inquiry (Bok, 2003; Readings, 1996). Although Ministers often pay lipservice to the hallowed, if perhaps somewhat hollow (Edgerton 2009), Haldane Principle that politicians should not be directly involved decisions about the detailed allocation of research funding, they have also been fierce critics of the tendency for publicly funded science to address narrowly academic questions to the detriment broader public concerns. Launching a broadside at UK social science research for being too "inward looking, too piecemeal… [and] too supplier driven", then Education minister David Blunkett complained of the tendency of research either to:

> address issues other than those which are central and directly relevant to the political and policy debate; or …when it does try to be directly relevant to the main policy and political debates, to be seemingly perverse, driven by ideology paraded as intellectual inquiry or critique, setting out with the sole aim of collecting evidence that will prove a policy wrong rather than genuinely seeking to evaluate or interpret impact. …[S]ocial researchers need to be more street-wise in their approach and in the conclusions they draw. At this point I have

> to admit that, on occasions, I too may let my prejudices over-ride the legitimate empirically based evidence (politicians have a tendency to believe research when it reinforces their own view). All of us, including myself, have to be a bit careful about this. Nevertheless, for researchers to tell my constituents that the perpetrators of vandalism, neighbour nuisance, all night parties, and health destroying noise and intimidation, are really the victims rather than the perpetrators does very little for the public credibility of social science!

As Blunkett himself concedes, policymakers have a tendency to support research that supports their own prejudices. Given the importance of independent (or at least alternative) contributions to the framing and conduct of democratic debate, there are dangers that reigning orthodoxies will go unquestioned or, crucially for public trust, appear to go unquestioned, if research is harnessed too closely to what policymakers currently regard as "central and directly relevant to the political and policy debate". In the UK, the comparatively centralized systems for research funding increase these dangers. Recent controversies in the UK over GM foods, MMR vaccination, and electromagnetic radiation from cellular telephones (Burgess 2004), to name just a few, suggest how interactions within the co-constructed worlds of science and policy can reinforce, sometimes without even acknowledging, what are in fact shared prejudices about the nature of particular environmental risks and key challenges in understanding and managing them (Wynne 2006).

A second concern is that the increasingly strategic orientation of government research funding will squeeze out curiosity-driven scholarship (e.g. British Academy, 2004). Partly this is a plea for acknowledging the value, in the very broadest sense, of research as an end in itself. But that defense of academic autonomy is reinforced by an instrumental argument about the economic value of serendipitous discovery and of so-called responsive-mode, or undirected, research funding as the best way of delivering it. Responding in House of Lords debate to Lord Drayson's call, as Science Minister, for a more 'strategic approach' to public science funding, the President of the Royal Society, Lord Rees (2009) insisted that curiosity driven research must continue to receive generous public support because:

> in science, engineering, and medicine, the pay-off for R&D sometimes takes decades… [and] biggest breakthroughs are the least predictable. Indeed, it seems topsy-turvy that a Government who are rightly reluctant to pick winners in industrial policy should aspire to do that upstream, as it were, in the field of research. It is surely in our own interests to support real excellence across the board.

Pointing to the long term nature of scientific research and its fundamental unpredictability, Lord Rees expressed concerns both about the Research Council requirement that applicants "state what the impact of their research will be" and about "a possibly undue focus on so-called priority areas".

Finally, there are also concerns about implementation. There is considerable ambiguity about what exactly is involved in a 'more strategic' approach to government science policy and funding, as the House of Commons as recently noted (2009). At times ministers have implied that this would involve a greater emphasis either on strategically important areas of research, such as climate change. Indeed in the 2009 Budget report, Chancellor Alistair Darling announced the Research Councils would be making (violating the Haldane Principal) the Research councils would "refocusing spend on new research priorities" (HM Treasury 2009: 130). At other times, the suggestion has been that science policy should shift to provide more support for applied and translational research. That was a key recommendation of the Cooksey Review (2006) of ***UK Health Research Funding***, convened in response to the controversial suggestion floated in Exchequer Gordon Brown's 2006 budget that the MRC and NHS research budgets should be merged report. However, Cooksey, while calling for closer coordination "to ensure UK health priorities are considered through all types of research", recommended preserving the institutional separation between the MRC, responsible for funding basic research, and the NHS National Institute for Health Research responsible for clinical and applied work.

Ministers (e.g. Curtis 2009), often supported by leading pharmaceutical firms and their research partners at elite UK universities, have also sometimes suggested that what is needed is greater concentration of scarce research funding to promote and protect international excellence. The decision by HEFCE to ring-fence funding from the 2008 RAE provided to universities for science subjects was widely interpreted as an effort to prevent the dilution of research funding that would have followed if the many 'pockets of excellence' located in the so-called new universities had been funded using the algorithm it has used previously. The difficulty is that as former polytechniques many of these new universities are often much more effectively engaged with business, especially small and medium-sized enterprises, than members of the elite 'Russell Group' of universities (Lambert 2003; Demeritt and Lees 2005). Thus the strategic desire to support international R&D excellence conflicts the desire to support more applied research, which is often done at new universities. There is also a regional dimension to science funding. The four universities receiving the most public research funding (Oxford, Cambridge, UCL, Imperial, UCL) are all located in the South East of England. Accordingly there is also a tension between the desire to harness the science base as an engine of national prosperity and the uneven geography of the science base.

REFERENCES

AHRC (2004) Royal charter. Arts and Humanities Research Council, Bristol. Accessed from http://www.ahrc.ac.uk/FundingOpportunities/Documents/AHRC%20Royal%20Charter.pdf

AHRC (2009) Leading the world: the economic impact of UK arts and humanities research. Arts and Humanities Research Council, Bristol. Accessed from http://www.ahrc.ac.uk/About/Policy/Documents/leadingtheworld.pdf

Blunkett D, 2000, "Influence or irrelevance: can social science improve government? Speech made by David Blunkett, Secretary of State for Education and Employment, to a meeting convened by the Economic and Social Research Council on 2 February" Accessed on 9 July 2004 from http://www.bera.ac.uk/ri/no71/ri71blunkett.html

Bok, D. (2003) Universities in the Marketplace: The Commercialization of Higher Education. Princeton: Princeton University Press.

Braben et al (2009) Modest revolt to save research from red tape Times Higher 12 February. Accessed from: http://www.timeshighereducation.co.uk/story.asp?sectioncode=26&storycode=405335

British Academy (2004) Response to the Government's Consultation Paper on

"Science and innovation: working towards a ten-year investment framework". Accessed on 18 August 2004 from http://www.britac.ac.uk/news/reports/sifresp/sifresp-html.htm

Brown G. (2009) Transcript of the Romanes Lecture given by the Prime Minister at Sheldonian Theatre in Oxford, 27 February. Accessed from http://www.number10.gov.uk/Page18472

Burgess A (2004) Cellular phones, public fears and a culture of precaution. Cambridge University Press, New York

Cooksey D A (2006) A review of UK health research funding. London: Stationery Office. Accessed from http://www.hm-treasury.gov.uk/d/pbr06_cooksey_final_report_636.pdf

Corbyn Z (2008) Denham goes back to basics on funding for science Times Higher Education 18 September. Accessed from: http://www.timeshighereducation.co.uk/story.asp?storycode=403604

Corbyn Z (2009) Scientists call for a revolt against grant rule they claim will end blue-skies research Times Higher Education 12 February. Accessed from: http://www.timeshighereducation.co.uk/story.asp?sectioncode=26&storycode=405350

Curtis P (2009) Denham: more vocational degrees are needed, 24 February, Accessed from http://

www.guardian.co.uk/education/2009/feb/24/universities-vocational-degrees

Demeritt D (2000) The new social contract for science: accountability, relevance, and value in US and UK science and research policy Antipode 32: 308-29

Demeritt D and Lees L (2005) Research relevance and the geographies of CASE studentship collaboration Area 37 (2): 127-37

Denham J (2009) Staying ahead: investing in research in the downturn. Speech by the Science Minister to the Royal Academy of Engineering, London, 19 February http://www.dius.gov.uk/news_and_speeches/speeches/past_ministers/john_denham/rae

DTI (2003) Innovation Report: Competing in the Global Economy: the Innovation Challenge (HMSO, London) Accessed on 18 August 2004 from http://www.dti.gov.uk/innovationreport/innovation-report-full.pdf

DIUS (2008a) Innovation nation CM 7345 Department for Innovation, Universities, & Skills, London Accessed from http://www.dius.gov.uk/publications/scienceinnovation.pdf

DIUS (2008b) A vision for science and society: a consultation on developing a new strategy for the UK. Department for Innovation, Universities, & Skills, London Accessed from: http://interactive.bis.gov.uk/scienceandsociety/files/A_Vision_for_Science_and_Society.pdf

Drayson (2008) 'Attacking the recession' report launch speech at NESTA, 4 December. Accessed from http://www.dius.gov.uk/news_and_speeches/speeches/lord_drayson/recession

Drayson (2009) Foundation for Science and Technology Lecture at the Royal Society, 4 February. Accesed from: http://www.dius.gov.uk/news_and_speeches/speeches/lord_drayson/fst

Edgerton D (2009) The 'Haldane Principle' and other invented traditions in science policy History & Policy[on-line journal], published 22 July. Accessed from: http://www.historyandpolicy.org/papers/policy-paper-88.html

Ezrahi Y (1990) The descent of Icarus: science and the transformation of contemporary democracy Harvard University Press, Cambridge

European Commission (2005) Communication to the spring European Council: working together for growth and jobs—a new start for the Lisbon Strategy. Com (2005) 24 final. Accessed from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2005:0024:FIN:EN:PDF

European Parliament (2000) Lisbon European Council, 23 and 24 March 2000, Presidency Conclusions. Accessed from: http://www.europarl.europa.eu/summits/lis1_en.htm

HMSO (1993) Realising Our Potential. Her Majesty's Stationery Office, London

HM Treasury (2002) Investing in Innovation: A Strategy for Science, Engineering and Technology, HM Treasury, London. Accessed from http://www.hm-treasury.gov.uk/media/FDD/8D/science_strat02_ch1to4.pdf

HM Treasury (2004) Science and innovation investment framework 2004-2014 HM Treasury, London. Accessed from http://www.hm-treasury.gov.uk/spending_sr04_science.htm

HM Treasury (2009) Budget 2009: building Britain's future, HM Treasury, London. Accessed from http://www.hm-treasury.gov.uk/d/Budget2009/bud09_completereport_2520.pdf

Holden K and DEMERITT D. 2008. Democratising Science? The politics of promoting biomedicine in Singapore's developmental state, Environment and Planning D: Society and Space 26: 68-86 doi:10.1068/d461t

House of Commons (2008) Science budget allocations, fourth report of session 2007-08 of the Innovation, Universities, Science, and Skills Select Committee, Stationery Office Ltd, London. Accessed from: http://www.publications.parliament.uk/pa/cm200708/cmselect/cmdius/215/215.pdf

House of Commons (2009) Putting science and engineering at the heart of government policy, eighth report of session 2008-09, Innovation, Universities, Science, and Skills Committee, Stationery Office Ltd, London. Accessed from http://www.publications.parliament.uk/pa/cm200809/cmselect/cmdius/168/168i.pdf

Lambert R (2003) Lambert review of business-university collaboration HM Treasury, London Accessed from http://www.hm-treasury.gov.uk/media//EA556/lambert_review_final_450.pdf

Lammy D (2009) The value of higher education in the arts and humanities, speech to the Royal Society for the Encouragement of Arts, Manufactures, and Commerce, London, 24 June. Accessed from http://www.dius.gov.uk/news_and_speeches/speeches/david_lammy/value_of_higher_education

Leadbeater C, Meadway J (2008) attacking the recession: how innovation can fight the downtown. NESTA discussion paper, National Endowment for Science, Technology, and the Arts, London. Accessed from: http://www.nesta.org.uk/assets/Uploads/pdf/Interim-report/attacking_the_recession_discussion_paper_NESTA.pdf

RCUK (2007) Increasing the economic impact of the Research Councils, Research Councils UK, Swindon

Readings B (1996) The University in Ruins, Cambridge: Harvard University Press.

Rees, M (2009) Science, technology and engineering debates, House of Lords, 4 June. Accessed from http://www.theyworkforyou.com/lords/?id=2009-06-04a.342.0

Roberts G (2002) SET for success: the supply of people with science, technology, engineering and mathematics skills. The Report of Sir Gareth Roberts' Review (HM Treasury, London) Accessed from http://www.hm-treasury.gov.uk/documents/enterprise_and_productivity/research_and_enterprise/ent_res_roberts.cfm

Roberts G (2003) Review of Research Assessment: Report by Sir Gareth Roberts to the UK Funding Bodies Accessed on 24 April 2007 from http://www.ra-review.ac.uk/reports/roberts.asp

Rorty R (1991) Objectivity, relativism, and truth Cambridge University Press, Cambridge

Sainsbury, Lord (2007) The Race to the Top: Review of Government's Science and Innovation Policies. London: HM Treasury. Accessed on 9 May 2009 from http://www.hm-treasury.gov.uk/d/sainsbury_review051007.pdf

Scottish Executive (2001) A science strategy for Scotland Scottish Executive, Edinburgh. Accessed from http://www.scotland.gov.uk/Resource/Doc/158401/0042918.pdf

Secretary of State for Trade and Industry, 1998 Our Competitive Future: Building the Knowledge Driven Economy (The Stationery Office, London) Accessed on 15 January 2005 from http://www.dti.gov.uk/comp/competitive/main.htm

Secretary of State for Trade and Industry, 2000 Excellence and Opportunity: A Science and Innovation Policy for the 21st Century (The Stationery Office, London) Accessed on 15 January 2005 from http://www.ost.gov.uk/enterprise/dtiwhite/index.html

Warry P (2006) Increasing the economic impact of Research Councils, advice to the Director General of Science and Innovation, DTI from the Research Council Economic Impact Group. accessed from: http://www.berr.gov.uk/files/file32802.pdf

Wynne B (2006) Public engagement as a means of restoring public trust in science – hitting the notes, but missing the music? Community Genetics 9: 211-20.

WORKSHOP COMMENTS

by Lisa Dilling

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The topic of "usable science" is of great personal interest, having worked both as a program manager funding research aiming to be used by society, and as a scholar understanding what the processes and barriers to such research might be.

Much of the scientific research conducted now is done as part of a large, semi-autonomous enterprise where public funds are used and justified for the benefits that science can bring to bear on societal needs. While the specific justifications may have changed over the years, economic benefits, and technological and military superiority have remained constant themes.

Second, it is my contention that many researchers hope or desire for their research to be useful to society. They may not have thought deeply about how to make that actually happen, but they are driven by a sense that they would like their work to matter in solving problems. Some researchers even might go so far as to state that they believe science should be the deciding factor in solving societal problems. While science is a critical function of our information gathering process for problem solving, science is rarely, if ever, the deciding factor. Nonetheless, I do believe that many scientists are motivated by thoughts of their research being useful to society.

These inclinations notwithstanding, scientists are rarely in the best position to judge exclusively what might be useful, or how it might be used. We have learned from extensive experience with applying seasonal to interannual forecasts, for example, that what a scientist thinks is interesting to study or useful to society is often not. From the specifics of the information itself, such as the variables, scale, and even disciplinary orientation, to the delivery of the information and its communication, timing, accessibility, and dissemination—creating conditions that allow for knowledge to actually be useful in a context is quite difficult and requires deliberate planning and action as well as appropriate actors and processes (e.g. Cash et al. 2006, Feldman et al. 2008, summarized in Dilling and Lemos in prep.).

Moreover, we know that knowledge applied without sufficient awareness of context can even be detrimental to some members of society (e.g. Broad et al. 2002, Lemos and Dilling 2007). In cases where inequity already exists, access to information and the ability to respond to it are also likely to be unequal. New information may thus exacerbate the very conditions it was meant to improve. At the very least, information delivered without sufficient awareness of the choices available to vulnerable individuals may simply fall by the wayside, be neglected or ignored. This can also occur in institutional settings where prescribed processes and procedures and lack of incentives to innovate exist (e.g. Rayner, Lach and Ingram 2005).

Opportunity costs are another negative consequence of failing to consider the context when generating and applying science intended to be useful. In a world of limited resources and political capital, research is often a substitute for action on other, more difficult fronts. If the suitability of scientific research (and its application) for solving a particular societal problem has not been adequately explored, it may be selected as a direction without actually being a viable solution in the end for the problem at hand. In turn, this may prematurely cut off discussion of alternative (and perhaps more difficult to implement) solutions that may in fact be more capable of solving a problem. See Shackley and Wynne (1995) for a discussion of this type of problem in the context of the pursuit of scientific uncertainty as a mutually determined pathway that can delay or foreclose consideration of less palatable but perhaps more effective solutions.

While usable science has been a vague and widely interpreted notion, it has served the goals of both science policy decision makers as well as researchers over the years. As in many policy situations, vagueness allows for multiple interpretations and "wiggle room" in the application of policy, enabling multiple activities to find a home underneath the concept. This convenience notwithstanding, budgets, military situations, and social developments have at various times put pressure on this existing arrangement. Some have questioned the relevance of large scientific programs to solving our pressing environmental problems (e.g. global change, acid rain) and researchers themselves find an ever more complex set of requirements for relevance to navigate. For the efficiency and effectiveness of both policy and human resources, therefore, it is timely to examine the notion of usable science and how we might clarify roles, expectations and priorities.

It is my assessment then, that usable science does indeed need to be more carefully unpacked and examined as this workshop aims to do. In work conducted in conjunction with Maria Carmen Lemos, we suggest a typology for understanding approaches to the production of usable science based on the degree of engagement with societal input and questions of societal values. We suggest that there are two important components to the notion of usable science to begin with: (1) whether information can be used in society, and (2) whether it can be used to improve outcomes. Certainly there are many circumstances of where information can be used period – whether for good or ill, to delay or accelerate a decision, to support or hinder a process. Information might be called "usable" simply because it is "used". We submit that a second criterion must be applied to the consideration of usable—that of the outcome itself. This introduces a normative component to considering whether information is usable or not, but an appropriate one we believe, because of the role society is affording to the production of science in the first place, to produce positive benefits.

Once the normative component is introduced, however, a host of considerations come into play that scientific processes are not used to dealing with normally. For example, I might think my information should be useful to preventing starvation in a poor area of the world, but it turns out, it is actually useful to preventing banks from going bankrupt from making bad loans in a drought year, leaving poor farmers to starve (Lemos et al. 2002). We cannot say that the information wasn't useful, it was—on the other hand, it certainly was not used as I might have predicted. How much control do we have over the use of information? How well can we understand a context before we decide to introduce new information into it? And who is the "we" who gets to decide these things?

Two questions are extremely important to ask in the formation of science policies for usable science: 1) Who defines what knowledge is produced; and 2) What is the context for application of the knowledge produced? Question (1) involves questions of power and influence, and Question (2) delves into questions of outcomes, equity, opportunity costs, and so on.

Depending on the answer to these questions, science policy decision makers aiming to create "usable science" might fall along a continuum of approaches with increasing levels of engagement with questions of societal values and norms:

1. not conceived for use, but serendipitously becomes useful
2. being conceived of for use, but perhaps in an abstract theoretical context
3. actually being used in some application, "usable"
4. actually being used to improve societal outcomes, "beneficially usable"

I argue that in the end, publicly-funded science must engage all the way to category 4. We have examples of programs that fall into each of these categories, and these can certainly continue, but only by considering policies in category 4 can we fully pursue what is needed to solve some of the pressing societal issues we are faced with. Category 4 implies full engagement and honesty with the tradeoffs and realities of when science can and cannot improve a situation. In turn, it thus provides the most promise for being able to efficiently contribute to a societal solution in an era of limited human and financial resources. These choices are already implicit in our scientific enterprise, but only become apparent when we see the outcomes of scientific knowledge applied.

The challenge of research in category 4 would be to envision potential outcomes as part of the research prioritization process, with enough societal engagement that the dimensions are more fully recognized than with our more traditional processes.

I look forward to the discussions of the workshop and hope that we might be able to explore more fully what the notion of usable science really means and how it might be more effectively implemented in practice.

WORKSHOP COMMENTS

by Mathias Friman, PhD Candidate at DWES/CSPR

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"AIM: CRITICALLY ASSESS HOW CALLS FOR USABLE SCIENCE PLAY OUT IN PRACTICE"

I'll try to present my very tentative view on this topic, primarily arguing that all science has always related to societal benefits; that all science is produced in society; that there is little wrong in explicating science as being simultaneously in and beneficial to society; and that, however, there is at least one foreseeable risk in doing so: explicating science as in society while also openly striving for societal benefits can lead to a conservative effect of already established perceptions of what is beneficial and not.

I'll try to sketch this tentative argument in briefly answering the questions posed to this workshop.

"FIRSTLY, WE WILL ASK 'WHY SCIENCE SHOULD BE LINKED TO SOCIETAL BENEFITS'."

For as long as science has been established as an knowledge producing procedure it has of course, at least in my mind, always been part of society. In understanding science as part of society, claims to being beneficial ought most always to have been a crucial criterion. Even when the argument has been that science has to be free and 'decoupled' from bias, the core argument for such free science has often been that it holds the key to the most unpredictable and most beneficial scientific revolutions. So-called 'critical sciences' too, are often motivated by being of crucial importance to society. Not least is this true to e.g. marginalized groups or in highlighting alternative societal development paths.

Science, in line with this argument, is always in society and in fact always motivated in a societal context, i.e. even when claims to objectivity are stated the research process take place in a societal context. Unrevolutionary as these claims might be, especially in the light of history, I think that they do motivate that researchers should take the political/ideological dimensions of science seriously, reflect upon it and present their general motives behind the direction taken in revealing the commonly hidden choices hefted to the scientific practice.

Why? Would such science be truer or more honest? I tentatively suggest so, at least more honest. I do not think that we can ever know if this also means that the general scientific practice hides a false ideology to be dismantled. My argument seems to suggest so being, but the proposed new framing too would be of similar kind. I try to entertain a slightly different argument. Instead, I do think that discourse prescribe what we think and how we act. A discourse on apolitical science can easily be misused in as well as be part of ideological struggles. This cannot ultimately be proven, in this framework, since such proof would be equally ideological. However, the failure of establishing objectivity in a highly contingent history seems to me as strengthening this argument.

Objectivity, many times, is a forceful companion in scientific argumentation and can surely also restrain politics from taking certain directions even if such are desired by some stakeholders. I do think that highlighting science as being in society rather than merely or mostly about society could decenter some of science's power. It could open the door to understanding science as an important ganger in creating knowledge, according to the logics of science yet without being apart from society and beneficial to the same. This in turn could be a key to enhancing democracy; to taking science one step towards a radicalizing of democracy where the motives behind science become as important as its results. While holding the potential of undercutting objectivity this by no means invalidates claims to reliability or validity, only reinterprets such categories in turn giving the academic ganger a new direction.

"SECONDLY, THE WORKSHOP WILL ASK 'WHEN IT MAKES SENSE TO LINK SCIENCE TO SOCIETAL BENEFITS.'"

In my mind, again very tentatively engaging in this discussion, openly accepting science as in society and having societal benefits (and drawbacks to others) most always seems to make sense. Even though it ought to be impossible and perhaps undesirable to control the after-life of scientific results (if and how it is interpreted and used), the researcher highlighting what s/he thinks could be beneficial could make the motives behind knowledge claims more accessible to the receivers and open up for debate. In turn, this also ought to somewhat restrict interpretations of the results, indicating what kinds of perspectives it is beneficial to, in turn making it more directly usable in traditional political contexts as wells as other parts of society.

I have, however, one warning flag: what seems most problematic, to me, is that if science is acknowledged as in society is science framed as such will only benefit established stories, stories with the preferential right of interpreting what is beneficial and what's not.

When free science can be perceived as free, and therefore highly beneficial, it can open up possibilities of financing research 'empowering the disempowered' or something like acknowledging problems of groups or the like, which have a hard time organising their stakes. For democracy, such science is important, not least because without acknowledging societal antagonisms democracy fails itself. However, if marginal or substantially critical research can be safeguarded also in a growth oriented world, than I see little problem with all attempts at talking about science in the world and not merely about the world – as science as inevitably political.

"FINALLY, THE WORKSHOP WILL ASK 'HOW TO BEST LINK SCIENCE TO SOCIETAL BENEFITS.'"

Of course, in this perspective it is impossible to foretell all ideological intentions or effects of scientific knowledge claims. My take at this –worth repeating, a very tentative such– is that it could be beneficial to acknowledge this dimension, the form, whereas the preciseness of the content with which this is filled is less important. The idea is not that the researcher can or should present all its ideology –being part of discourses in any case may mean that awareness of its central assumptions is hard or impossible to reflect upon. The regulatory framework of how to preserve science of importance to democracy, I dare not discuss here. To democracy, the important issue is that we do not simply get a consultant academy where scientific knowledge has to generate patents and easily measured GDP. If that would be the result of accepting science as in society while also demanding it being beneficial to society, and the democratic argument would have a hard time being heard in the noise of the gross domestic product choir, I would probably prefer science being framed as primarily about society.'

WORKSHOP COMMENTS

by Erik Glaas, PhD Candidate at DWES/CSPR

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AIM:

The explosive meta-theoretical development of "user-inspired" or "co-productive" research, often conceptualized as "transdisciplinarity", has impacted research agendas and policy directions by funding organizations over the last decade. The cannons promoting this development describe clear shifts towards a socialisation of science where the production of knowledge corresponds to the needs of society. As transdisciplinary research, though, is quite broadly defined as meta theory, and difficulties is surrounding stakeholder participatory research in practice, I found it interesting to study how projects with an aim of being transdisciplinary does define and practice this concept.

In this short discussion input I take departure by presenting some results from a recently performed study were I have reviewed and analyzed articles describing such declared transdisciplinary research agendas, which I prepared for a PhD-course last fall. A search was made for: ***transdiciplinary*** + ***sustainable development*** and ***transdiciplinary*** + ***climate change*** in the database Academic Search Premier. In total 36 articles from a wide range of journals were listed. During the review two main questions were asked to the texts: 1) How is transdisciplinarity defined?, and 2) What key aspects is according to the author(s) important to consider when working transdisciplinary? I will use the results from this study in trying to give my view on the questions central to this workshop.

1. WHY SCIENCE SHOULD BE LINKED TO SOCIETAL BENEFITS

Even though it risks not being a spot-on answer to this question, I have scrutinized tree categories of definitions of transdisciplinarity in the articles, which are presented here. In the firs category, which I call broadening academic perspectives, academic researchers from different disciplines has initiated a project according to a pee-set research agenda in which they, due to the complex and context dependent nature of the issue, have recognized the importance of including stakeholder knowledge and values, which are added to the project inputs. In this case stakeholder voices can contribute to the results of the project, but the project ought to be seen as academic research with stakeholder involvement. In the analyzed projects that falls under this category the researchers brought or produced academic concepts which were used to develop plans or strategies for an area. The results can in the ideal case be used as policy foundations and hence my have the potential to lead to some societal benefits.

In the **second category**, ***cooperative research***, both non-academic stakeholders and academic researchers from different academic disciplines are included in the problem formulation, project design and knowledge production throughout the project. All members should feel project and result ownership, but the visions and goals are separated. Academic researchers are ultimately both driven and pressured to produce academic contributions, whilst the non-academic stakeholders are driven by other demands. The project hence might have the potential to produce societal benefits if the problems are formulated in such manner

In the **third category**, ***shared visions***, academic researchers from different disciplines and non academic stakeholders have both observed a problem which all participants are driven to overcome. The project are initiated, designed and guided by all involved participants who strive for the same goal, to solve the problem. None of the reviewed projects falls directly under this category, only parts of projects. This is not strange. Project of this type would not have academic publication as a primary ambition since they are strictly problem solving. This kind of project might be such as described in some of the meta-discussion of transdicsiplinarity, and might not be applicable in reality, or at least, not for longer periods of time, such as a research project.

So, by judging from the reviewed articles, transdisciplinary projects have the potential to contribute too at least four different types of benefits: to produce better and consensual academic research results, informed decision foundations, joint problem understanding, and "real" problem solving. What "real" problem solving means does of course opens up for discussions, but ought to be highly contextualized in practice.

2. WHEN DOES IT MAKE SENSE TO LINK SCIENCE TO SOCIETAL BENEFITS?

The compilation of the analyze above shows that the concept of transdisciplinarity is broad but do in all analysed cases symbolize an interaction or involvement of non-academic stakeholders in all the environmental projects, but the involvement is initiated in different parts of the projects and stakeholders seems to play different roles in the production knowledge. So, when does it make sense to link research to societal benefits according to this small study? Well preferably when some of the potential benefits above are a declared goal in the project idea.

3. HOW TO BEST LINK SCIENCE TO SOCIETAL BENEFITS?

But how, then, can this third category of knowledge co-production be reached, if that is desirable? Non-academic stakeholders and researchers need to jointly form the goals, visions and problems, but at the same time seek out solutions to these problems which in format not automatically, or even likely, go in line with demands put forward by established cultures, funding policies or politics (fig 1). I think it's important to realise that knowledge co-production is not something possible to run static over time since all participants: first often are driven by different objectives and secondly are influenced by different demands in society. If realising that joint problem solving only is possible in short periods of time, and if discussions are expanded on what following demands (such as the higher demands for produced peer reviews) are implying for the co-production of knowledge, conditions for societal benefits of science can better be understood.

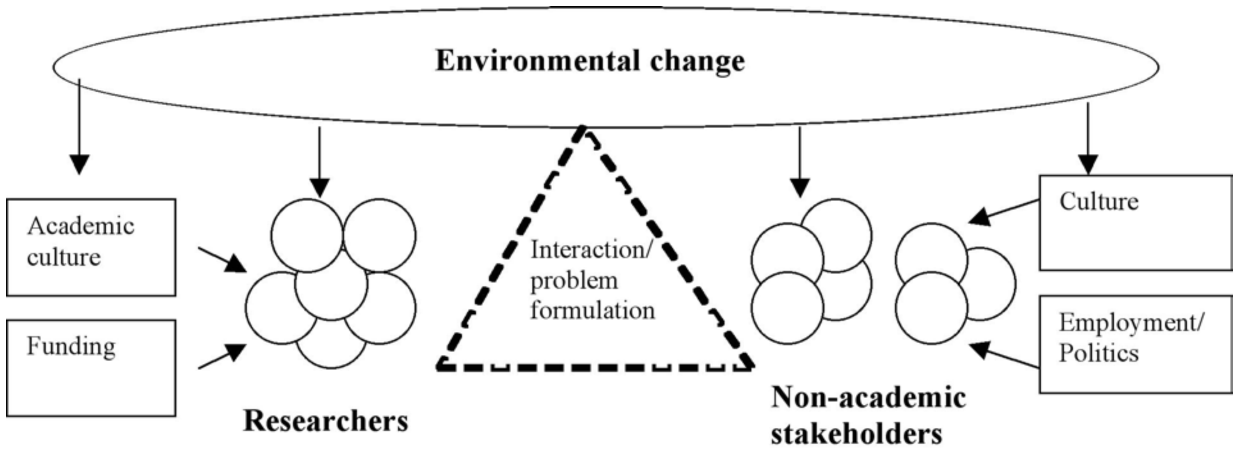

Fig. 1, conditions for knowledge co-production

WORKSHOP COMMENTS

by Reiner Grundmann

Aston University (UK)

I address the three thematic questions in the order they were posed in the invitation:

1 'WHY SCIENCE SHOULD BE LINKED TO SOCIETAL BENEFITS'.

I would like to point out that attempts to increase the social usefulness of science could lead to its social uselessness. Of course, everything depends on definitions here, but it seems to be worthwhile to point out this paradox. Let us assume that science (among other institutions in modern society) provides a pool of knowledge which provides options for society. This pool should be open. Openness means that the targeting of specific goals at the expense of its variety could undermine the function of science and knowledge in society. Knowledge is not always instrumental. One precondition of becoming instrumental (there are others) is that knowledge contains variables that can be controlled by social actors, especially decision makers. Only if knowledge identifies the causal mechanisms that can be influenced one way or other does it provide the levers for action. In this sense much knowledge is not instrumental and it is a category error to demand of knowledge that it should be 'useful' in this sense.

There is another caveat I would like to make at the outset. This has to do with the desirability of public involvement and the basis for the legitimation of instrumental knowledge. I a forthcoming book I am writing together with Nico Stehr, we examine the cases of eugenics (race science), Keynesianism and climate change. While many would argue that we know what useful knowledge and its virtues are in the case of economic policy and climate change, eugenics provides a different lesson. One of the goals of this enterprise, a 'healthy' population (or a gene pool free of hereditary disease and the like), has some unpleasant overtones that exemplify the deep problem associated with such an enterprise. Nevertheless, the project of eugenics was supported by the most eminent scientists at the time (not only in Germany) and resonated with deeply held beliefs by the public and political decision makers (and there contemporary projects underway). If this example serves as cautionary tale, we might also extend the critical inquiry to economic policy and climate change and ask: what exactly do we want to achieve in practical terms through knowledge production in this area? Is it a crisis free economy in the first case and a stable climate in the second? Or, if these are utopian goals, do we aim at more social justice given that repercussions have an unequal impact on different social groups? It is these questions that need to be asked. They often get neglected since everyone seems to assume that we all know what 'socially beneficial' means.

The workshop invitation states that 'despite the recent celebration of public involvement in the production and use of scientific knowledge, a quick review of the literature in this field suggests that the debate is marred by murkiness. The lack of clarity is partly related to the range of different normative and substantive justifications for usable research. The workshop seeks to bring clarity to these theoretical justifications and assess how they hold out in practice.' Let me therefore briefly rehearse three well known approaches from the literature, Latour, Funtowicz/Ravetz and Nowotny.

a) Latour's criticism of the two world doctrine:

Drawing on Shapin and Schaffer's ***Leviathan and the Air Pump*** (1985), Latour argues that we need to overcome the separation of science on the one hand and political theory on the other if we want to understand contemporary issues such as climate change or genetically modified foods. Latour points out that the science of Hobbes and the political philosophy of Boyle were each deleted from the picture by subsequent commentators and generations. Today we see in Hobbes the great political philosopher, in Boyle the great scientist. Latour comments:

> 'To Hobbes, the Leviathan; to Boyle, the air-pump. The modern world was born. I define

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> a world as modern when the political constitution of truth creates those two separate parliaments, one hidden for things, the other in the open for citizens. A no man's land was created along this new boundary. But what happened to all the mixed questions I have presented at the beginning, to all these imbroglios of political and scientific affairs, these tangles of ozone layer, frozen embryos, dying whales, printed chips, electronic money, and rain forests? They have grown, and grown, and developed for three centuries, and populated the no man's land to such an extent that today every problem seems to be crowded on this tiny borderline, and there is not much left on the two extremes: something purely social? Something purely natural?' (Latour 1991:15).

We should, argues Latour, be encouraging each other, across the great divide, to critically examine knowledge claims from relevant fields, even if we are not the 'specialists'.

This is an argument about a changed reality, the limits of traditional epistemology and a call to study empirical phenomena that are not fitting into established disciplinary categories. One might find this a commendable strategy, although it leaves open the question of how a new science could be established that enables us to study such hybrids. At the time of writing, Latour may well have entertained the hope that the new field of Science and Technology Studies would play such a role. Subsequently he has come to a much more pessimistic assessment.[1]

b) Funtowicz and Ravetz– values and uncertainty

Even before Western societies witnessed the emergence of risk controversies on a large scale, Weinberg has pointed out that 'there are answers to questions which can be asked of science and yet which cannot be answered by science' (Weinberg 1972: 209). Funtowicz and Ravetz (1992) have argued that formal models (risk statistics) are inadequate since they do not help to deal with uncertainty. Scientists are like lay persons when operating within a value-laden context where facts are uncertain, values in dispute, stakes high, and decisions urgent. Experts are amateurs when uncertainties exist. Funtowicz and Ravetz argue that we therefore need a dialogue among all the stakeholders in a problem, regardless of their formal qualifications or affiliations, an 'extended peer community'. It is because the risk calculus cannot be applied that experts do not have a better grasp than lay people. Lay people should therefore have the same say in these decisions as experts.

This is again an argument about changed reality, the process of decision making, and it should be noted that the notion of extended peer-review is not intended to apply to the procedures of science (e.g. research papers are not sent out to members of the public for review before they are considered for publication).

c) Nowotny – Context dependent science and social robustness

Nowotny argues that the old ideals of scientific objectivity and autonomy have gone. The role of science has changed in modern society, it is no longer providing truth, but at best reliable knowledge. She describes these changes not only as a challenge for researchers (who have to adapt) but as an opportunity.[2] This is because she interprets the process of knowledge creation in contexts of application as one where public participation is called for. It seems to me that she tries to make a virtue of necessity. I tend to disagree both with the diagnosis and normative endorsement as both rest on a false premise.[3] The premise is encapsulated in the following statement:

> 'As social studies of science have revealed, the seemingly impersonal structure of science

1. '[F]ortunately (yes, fortunately!), one after the other, we witnessed that the black boxes of science remained closed and that it was rather the tools [of science studies] that lay in the dust of our workshop, disjointed and broken. Put simply, critique was useless against objects of some solidity." (Latour "Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern," Critical Inquiry 30 (Winter 2004): 242.)

2. Major challenges include reduced levels of funding and pressures to justify research, over and above being a 'cultural' activity. This is where public pressure and utilitarian aspects enter the picture.

3. There are other premises which could be queried, and I am aware that I am giving a highly stylized account of all positions summarized in my comments.

needs to be complemented by another side, which is governed by agency and inhabitated by agents, human and non-human alike. Their interaction makes for much more interesting and realistic accounts of how scientists work than the post-hoc narratives of the smooth triumphs of scientific achievements. Such an image of science - in the making - has been widely accepted today, not only by science-policy makers and social scientists, but equally by working scientists.' (http://www.itas.fzk.de/deu/tadn/tadn993/nowo99a.htm)

There is plenty of evidence that working scientists and decision makers reject such a view. The traditional, linear model of science policy relations is alive and kicking. Science and technology studies have made little impact. The Science Wars made waves in the Humanities but not in the Sciences. Scientists do not read work from STS scholars, and even historians do not read the work of history of science scholars (Daston 2009). The appeal of the linear model may be explained with its being a useful fiction that satisfies all actors involved. It enables policy makers to justify their decisions with reference to scientific authority; it enables scientists to be proud of their knowledge which has made an impact; and it persuades the public that no one has been unduly influencing knowledge production.

To sum up: of the approaches presented above, the last is the most radical. It not only describes a new reality but hints at reasons for its desirability. However, it rests on questionable premises. In comparison, the other two approaches are much more limited in their scope. Latour wants to overcome the big divide between disciplines in order to study hybrids, and Funtowicz /Ravetz want to open political decision making to non experts.

2. 'WHEN IT MAKES SENSE TO LINK SCIENCE TO SOCIETAL BENEFITS'.

Collins and Evans (2002:241) point out that science and politics operate on different time scales:

'[D]ecisions of public concern have to be made according to a timetable established within the political sphere, not the scientific or technical sphere; the decisions have to be made ***before*** the scientific dust has settled, because the pace of politics is faster than the pace of scientific consensus formation. Political decision-makers are, therefore, continually forced to define classes of expert ***before*** the dust has settled – before the judgements of history have been made. In defining classes of expert actors in the political sphere, they are making history rather than reflecting on it.'

From this it follows that there is no synchronization of the cycles of policy and science. It underlines the point made above that scientific knowledge may be used ***later*** in order to justify decisions that already have been taken.

At first sight Collins and Evans seem to share a similar concern when trying to distinguish expert and lay roles in the process. However, they confuse the process of political decision making (and of public discourse) with the process of scientific research. They argue that lay people are no experts and thus should not have an influence equal to the experts. Collins and Evans defend their privileging of expertise in Western democratic societies by a factual statement drawing on the role of culture ('this is our way of life') and by a normative statement ('this is how things should be'). The models they propose for a 'third wave' of science studies owes much to Collins' earlier work on core-sets in science. Core sets are core groups of scientific experts who do the most important research on a novel issue and ultimately decide about the merits of the contested truth claims.

As a result of their starting point with core sets, Collins and Evans tend to lose sight of the more general and perhaps more important question of who should have a say in political decision making. They treat the participation in the discussion of truth claims on the same level as the participation in the discussion of decisions regarding public policy. This is where they are led astray. The core set model is misleading in this context since extending the core set of scientific decision making betrays the authors' focus on science as the centre for decision making in society. If one shifts the focus to societal and political decision making, the question becomes one of defining the appropriate influence of science ***among other voices*** in such debates. The 'problem of extension' (Collins and Evans's term for opening up decision making) is a problem for a science-centered view. For a view focusing on decision making in a broader sense it becomes a problem of stakeholder participation.

Steven Epstein deals with a similar issue in his study ***Impure Science***. He shows how patient groups and grass roots activists have influenced policy decisions about AIDS treatment as well as practices in clinical trials and scientific research. In his account it would not make sense to speak of an extension of the realm of scientific practice to include lay perspectives. Lay pressure has proved much more influential than just providing some additional input to the experts' discourse which – at least according to Collins and Evans -- remains central. Not much remains of the central role of scientific expertise when we look at the list of achievements by the activists:

> 'Their publications have created new pathways for the dissemination of medical information. Their pressure has caused the prestigious journals to release findings faster to the press. Their voice and vote on review committees have helped determine which studies receive funding. Their efforts have led to changes in the very definition of 'AIDS' to incorporate the HIV-related conditions that affect women. Their interventions have led to the establishment of new mechanisms for regulating drugs, such as expanded access and accelerated approval. Their arguments have brought about shifts in the balance of power between competing visions of how clinical trials should be conducted. Their close scrutiny has encouraged basic scientists to move compounds more rapidly into clinical trials. And their networking has brought different communities of scientists into cooperative relationships with one another, thereby changing patterns of informal communication within science.' (Epstein 1996:338-9).

In terms of time frames, this example shows how the 'non-scientific' activities of pressure groups have led to a redefinition of scientific practices in a relative short time span.

There is another aspect to consider here. Changing the focus from scientific expertise to public policy, it becomes evident that we are dealing with the issue of articulating public values. Posing the problem this way makes it evident that a view centered on scientific experts lacks plausibility. As Guston (2008:940) pointed out, 'even if scientists might have some monopoly over the technical knowledge in their chosen field, they have no similarly exclusive take on the vast bodies of knowledge and practice implicated in turning their discoveries into actual innovations or policy decisions.'

3. 'HOW TO BEST LINK SCIENCE TO SOCIETAL BENEFITS'

A problem for democracy or a problem for science?

Many political issues are decided with a high dose of expert opinion. From this two extreme consequences can be drawn. There are those who argue that we need more and more wide ranging expertise and those who argue that in democratic societies it should be citizens who have the ultimate say about important decisions, no matter what the expert consensus says (if there is such). The first option places expertise in the political game where stakeholders will try to influence expertise in order to get the desired political outcome. The second option places the citizen in the centre of decision making and diminishes the role of expertise for decision making. It is up to the citizens to use expertise as the basis for decisions.

The British newspaper ***The Guardian*** reports in its edition of August 27 a comment from Nassim Taleb, author of the widely acclaimed book on the financial crisis, ***The Black Swan***. He says about climate change and the role of expertise: 'My position on the climate is to avoid releasing pollutants into the atmosphere, regardless of current expert opinion. Climate experts, like banking risk managers, have failed us in the past in foreseeing long-term damage. This is an extension of my general belief: 'Do not disturb a complex system.' We do not know the consequences of our actions (this idea also makes me anti-war), and I have explicitly stated the need to leave the planet the way we got it.'

If the problem is seen as a problem for democracy, we could envisage solutions along Taleb's reasoning above. If the problem, however, is seen as a problem for science, we face a different set of issues. There is the danger to undermine the very foundations of the scientific enterprise since concerns about social usefulness will not always spurn scientific innovation. On the contrary, if the institutional framework of science rewards utility aspects disproportionally, there is the danger that not-so-useful research (at least at face value) is crowded out. This may be an extreme, yet possible outcome. In the UK, research councils nowadays request that grant applications include a section on economic impact.[4]

We will also see the emergence of different ***advocacy coalitions*** comprising scientists, business people, NGOs and policy makers. It is not only that citizens, business interests or politicians demand something from science, scientists themselves will offer their resources, findings and advice (either because they want to gain resources or fame or because they act out of 'moral duty'). Here we have to ask the question again: how can we link science to societal benefits?

Can we learn something from pragmatist philosophy, as developed by Dewey? Like other pragmatists Dewey set himself apart from a view of science that conceives of generating scientific knowledge in strict isolation from the affairs of everyday life or merely in the interest of a small segment of society. In the eyes of pragmatism, the virtue of social science is its close affinity to the problems of the day.

The realization of a democratic public requires, as Dewey (1927: 208-209) stresses, an 'improvement of the methods and conditions of debate, discussion, and persuasion. That is the problem of the public.' The improvement of public discourse depends, as Dewey also repeatedly emphasizes, 'upon freeing and perfecting the processes of inquiry and of dissemination of their conclusions. Inquiry indeed is a work which devolves upon experts. But their expertness is not shown on framing and executing policies, but in discovering and making known the facts upon which former depend.' Therefore the intellectual division of labor between science and the public does not vanish. Scientists 'are technical experts in the sense that scientific investigators and artists manifest expertise. It is not necessary that the many should have the knowledge and skill to carry on the needed investigations; what is required is that they have the ability to judge of the bearing of the knowledge supplied by others upon common concerns.' (Dewey 1927:208-9).

Dewey describes rather well that we should distinguish between the processes of knowledge creation and political decision making. However, we have to take into account a changed reality: today we see sometimes experts indeed engaged in the framing of policies. This is the case when they have instrumental knowledge to offer for which they identify practical applications. The same applies when scientists act as advocates.

With the coming of the knowledge society, we could come, at least in principle, a step closer to Dewey's hope expressed in the last sentence. The proliferation of knowledgeable interest groups can serve the function of judging the 'bearing of the knowledge supplied by others upon common concerns.'

4. On the ESRC website we find the following statement: 'Like the other Research Councils, ESRC describes impact as the demonstrable contribution that excellent research makes to society and the economy. It embraces all the extremely diverse ways in which research-related knowledge and skills benefit individuals, organisations and nations, such as: fostering global economic performance, and specifically the economic competitiveness of the UK; increasing the effectiveness of public services and policy; and enhancing quality of life, health and creative output. Impacts from research can take many forms, become manifest at different stages in the research life-cycle and beyond, and be promoted in many different ways.' (http://www.esrcsocietytoday.ac.uk/ESRCInfoCentre/Support/esrcexpectations/faq.aspx#q4). Answering an imaginary question from a potential user, the FAQ section seeks to clarify: 'The new Impact Summary and Plan seems to be asking me to predict the future, is this the case?' – 'The Impact Summary and Plan are not intended to invite applicants to predict future benefits of the research. Its purpose is to allow the applicant to highlight potential pathways to impact, and to allow the Research Councils to support them in these activities.' (ibid.)

WORKSHOP COMMENTS

by Benjamin Hale

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WHY SCIENCE SHOULD BE LINKED TO SOCIETAL BENEFITS:

It shouldn't—at least not if benefits are understood in narrow terms, such as utility, welfare, or desire satisfaction. Surely some accounting for benefits is important, but it would be just as big a problem for science to be linked to societal benefits as it would be for science to ignore benefits, or to be done strictly for science's sake. 'Benefits' are the easy objective. I hesitate to qualify what I'm about to say as a "middle ground," but for shorthand purposes, it may help to think that way.

Consider briefly how the term 'benefits' is usually meant. Generally, benefits language is used to translate multiple conflicting (arguably, incommensurable) values into one monotonic value. The idea is to assign a utility to, or "to put a price on," health, lives, well-being, integrity, beauty, awe, among other such values. These are our 'benefits': sometimes framed as 'welfare', sometimes framed as 'happiness', sometimes framed as 'dollars', 'euros', or 'utils'. It's a very reductive endeavor.

Now consider that there have been a great number of scientific experiments done in the name of benefits that otherwise ought not to have been done. Certainly, we can conjure up innumerable instances of medical experiments that have jeopardized the lives or health of some in order to benefit many. The Tuskegee Syphilis Study offers one such infamous case. It is a paradigmatic cautionary tale of science done with benefits in mind, and the interests of persons in the dustbin. We can also easily overlay similarly horrible practices onto cases of nonmedical benefits, like genetic modification of crops, distribution of nuclear facilities into poorer neighborhoods, climate modification and geoengineering, social engineering and behavior modification, urban rezoning and improvement, educational tracking… the list goes on.

Of course, the promise of 'benefits' talk lies precisely in this simplicity: it clumps all values, including health, lives, well-being, integrity, beauty, awe, and so on, into categories of goods and bads; and from that, permits comparisons. On its face, it offers a neat and tidy way to handle conflicts of interest; and ultimately, conflicts of values. Benefits approaches are made all the more compelling if one understands values as subjectively grounded, where even claims about the so-called "value of a life" boil down to little more than individual belief, or at best, cultural norms. But there's a very strong tradition in ethics—indeed, encompassing at least two of the three major camps of ethicists, both deontologists and virtue theorists—that rejects many of these consequentialist suppositions outright; that proposes, instead, that we should look closely at the principles, responsibilities, duties, and/or virtues that motivate and guide us..

Nevertheless, the benefits bogeyman pokes his gnarly nose into every cranny, and the nooks of non-consequentialism are no exception. There have been many attempts to capture even some of these non-consequentialist considerations—like rights, obligations, duties, and virtues—in benefits language, thereby offering an enticing elixir to the ambivalent rights or virtue theorist. It is simply "business as usual" for well-intentioned number crunchers to collapse rights into values. That's what most of the past thirty years of environmental economics has devoted itself to. That's what kept the Ford Pinto spinning unsafely at all speeds. That's what encourages many policy commentators to scold dissenters who think otherwise—who claim that the benefits ship will never float—that they are overly idealistic, or at minimum, not realistic.

But it's nonsense. ***Complete*** nonsense. There are irreconcilable conceptual paradoxes that emerge when we take on the task of specifying safety standards, comparing dollars with lives, or rights with willingness-to-pay.

What someone is willing to pay to abdicate their responsibilities to others, or what they are willing to accept as compensation for the abandonment of their rights—neither of these figures can ever catch up with rights-captured or -seized, particularly if consent (whether hypothetical or actual) plays no role in the abridgment or usurpation of those rights. It is one thing for me to agree with you (publicly or privately)[1] that I will sell my farm for a million dollars, and then for me to sell it to you. It is quite another for this information to be extracted from me in a way non-inclusive of my agreement (public or private)—perhaps a neuro-scanner has been surreptitiously attached to my bedpost and my willingness-to-pay sucked from my brain, without my willful reflection over what price I might set—such that you then deposit the same amount of money in my bank account and subsequently ***take*** my farm. In the first case, my agreement has been ascertained and I have been justly compensated, with no wrong done. In the latter, my agreement has been elided, and I have been egregiously wronged.

So I think I'll go the distance and say that benefits talk is dangerous talk, even though the outcomes of any given action, or any given scientific research project, may be beneficial to all. I recommend scrapping the term altogether.

Having made such a strong claim, it would be smart to observe that it is just as clear, if not clearer, that many people do not know what is good for them, by which I mean…what is to their benefit. I think this is also true. Many people are irrational, incompetent to judge, uninformed about the facts, and sometimes, just plain crazy. They don't know medicine, they don't understand science, they don't bother to examine the full implications of their actions, and like fools led to slaughter, they insist upon the priority of their convictions. At the most charitable, they are "boundedly rational," though I think Herbert Simon was being overly kind (Simon 1957). Ironically, scientists and policy makers often point out this irrationality, I think, in a fallacious appeal that seems to offer ***carte blanche*** justification for public policies or scientific research. "We know that overall benefits will outweigh costs," they intone, "but we cannot rely on the whims of multitude to guide us in this important matter. As experts, we proclaim our research necessary, permissible, right, justified." Take your pick.

What this directs us to, it seems to me, is a need not to refine our understanding of benefits, but instead to abandon the benefits ship and begin thinking in alternative terms. We need to think in terms of ***what makes sense***, what is ***justified***, whatever meets with a strict procedural justificatory threshold.

Now what might this mean? You may be thinking that this is what we've been after all along. If we have a clear definition of benefits, and we can say that benefits outweigh costs, then we will have ***'justified'*** our actions or our research on grounds spelled out by one of many variants on Bentham's and Mill's Greatest Happiness Principle—that an act is right or justified if it brings the "greatest good to the greatest number." Seems we will have fulfilled the strict justificatory threshold that I'm seeking.

I disagree. Enticing though this response may be, it is upside-down thinking. There are countless examples of real-world repugnant conclusions and mere addition paradoxes (Parfit 1986) that speak to the inefficiency of this as a standard. Every scientist, policy wonk, and policy scientist should

1. Agreement is tricky here. I can agree either by giving consent, or I can agree by being in agreement with (and thereby technically neither giving nor denying consent). Consider a bargaining scenario in which we are negotiating over the price of my farm. I am willing to accept $1 million for my farm. ***Public Agreement Scenario***: You make an offer of $1 million. In accepting, I will have consented. ***Private Agreement Scenario***: You give me $1 million. I neither accept nor reject, but harbor as a secret price a $1 million threshold. Two possible horns of private agreement: (1) practical non-coercive agreement: I maintain a real, un-coerced possibility of rejecting. You take my farm. I do nothing to stop challenge this, though I easily could. Agreement has been reached, while no consent was offered; (2) hypothetical coercive agreement: I have reflected on the price of my farm and agree, without stating so, that the price I am offered and given is fair. I maintain no possibility of rejecting the offer. I could not do otherwise, so consent is moot; nevertheless I agree with the offer.

have in their back pocket a litany of real-world cautionary tales like the Tuskegee Study I mentioned above.

Instead, it would help to think of 'what is justified' in terms similar to 'what it is to be ***guilty***'.

In most systems of justice, for instance, we have clearly specified codes and procedures that detail the conditions under which a defendant is found guilty. In most cases, it is only upon the pronouncement of guilt from a suitably qualified and empowered judge that said defendant is designated as guilty. This usually follows an elaborate process of justificatory appeals and reason giving. The objective of such a process is to reach the correct, the right, the ***justified*** conclusion.

Now, of course, one presumes a lurking metaphysical fact about the defendant's guilt, and that is partly what we're after when we say that the jury and the judge arrived at the 'right' or the 'justified' conclusion. Either the defendant did what he is accused of doing, or he didn't. We might say that OJ is guilty, for instance, whether he was found guilty or not. But that's only on one way of thinking about being guilty. We might also say that OJ is guilty only upon being pronounced guilty. We would then observe that a defendant is innocent until proven guilty, which ultimately is established the moment that the judge utters that harrowing word: "Guilty!" The judge doesn't just say something when he slams his gavel on his oak desk, he ***does something*** with his words (Austin 1975). His performative utterance ***makes*** OJ guilty, or in this case, not guilty.

Plainly then, there are weaknesses with understanding guilt, and by extension, justification, in this pragmatic way. The verdict of judge and jury could be quite wrong, in the sense that it doesn't line up with facts in the world. But consider how follow-up court appeals are generally adjudicated and reassessed—by claims about how the process of jury selection was hijacked, or about how the institutions requiring burden of proof failed. These are principled concerns regarding the procedures by which such a determination was made. Again, calling into question the final judgment, but always after a reassessment of what is justified.

These sorts of appeals are made because we want to ensure that factors regarding guilt or innocence are fairly and justly taken into consideration. A grievance against a judge's finding is a ***justice claim***, not strictly a claim about factual accuracy. His trial wasn't ***fair***, they say. The deck was stacked in his favor.

So this little invective gets me back, at long last, to the topic of this workshop: science, benefits, and justification.

If we understand the task of science as that of doing what is justified, by which we mean what is most beneficial, or more beneficial, then we have been enticed by the elixir of neoliberalism, collapsing interpersonal rights and fairness questions into concerns about good and bad. The Rousseauvian general will, the Kantian critique of hypothetical imperatives, the Rawlsian doctrine demanding justice as fairness, are all buried in the serpentine labyrinth of utility, benefits, and welfare. That's a distillation that all scientists and policy makers should reject. Instead, scientists and policy makers should heed the input of the non-consequentialists, of those who demand that serious moral and practical attention be given to concerns about rights and duties.

When, then, does it make sense to link science to societal benefits?

It makes sense to link science to societal benefits when those affected by the science agree—or could or would agree, provided that fair democratic decision-making processes are in place and followed—to the benefits. Science, scientific research, science policy, technological interventions are justified only when strict, communicatively-ratified, validity conditions are met (Habermas 1994; 1991; 1998; 1970; 1987; 1987). We can weed out the influence of the irrational crazies this way, but we can also assess the strength of counter-claims—about justice, rights, respect, duties, obligations—that we might not otherwise anticipate. These concerns are prior to, or have priority over, benefits.

How do we do this?

We do this by opening the doors of scientific inquiry very wide; by allowing non-expert commentary and criticism on all scientific projects. We do this by inculcating in scientists an openness to criticism that operates along the validity axis of norms, and not strictly along the validity axis of truth. We do this by inveighing against the benefits paradigm, by opening channels of criticism, by assuming a negative stance with regard to our projects, and by inviting normative criticism upon ourselves, much as the scientific method challenges other scientists to demonstrate the descriptive weakness of a research finding.

All scientific endeavors have their defendants and their detractors. It is vital for science to weigh the counterclaims of all parties—not just other scientists—on grounds of their reasonable and rational validity, grounds that are by their nature wider than the standards of instrumental rationality imposed by the blinders of the empirical method or by the leveling weight of the benefits steamroller. My personal investment is in philosophy, but I think honestly that philosophers—scholars trained in an array of argumentative methodologies—should work side-by-side with scientists and policy makers to clarify and spell out the goods and bads, the rights and wrongs, the harms and benefits, of research. Just as a team of carpenters builds a ship, so too should academics work collectively to address the breadth of normative and descriptive dimensions that characterize scientific research.

What I've argued is that science and the scientific establishment cannot find their precious justification in so monolithic a concept as benefits. In its one-dimensional monotonicity lies its potential to do great harm, to commit great wrong. Justification must always be filtered through the lens of other important moral concepts as well. Science is right only when it is justified. It is not right when it is to the benefit of all, nor is it ***justified*** by being to the benefit of all. It is to the benefit of all, only when it right and justified.

References:

Austin, J. L. How to Do Things with Words. Edited by J. O. Urmson and Marina Sbisá. 2nd ed. Boston, MA: Harvard University Press, 1975.

Habermas, Jürgen. Between Facts and Norms. Translated by William Rehg. Cambridge, MA: MIT Press, 1994.

———. "Discourse Ethics." In Moral Consciousness and Communicative Action. Cambridge: MIT Press, 1991.

———. On the Pragmatics of Communication. Edited by Maeve Cooke. Cambridge, MA: MIT Press, 1998.

———. "Technology and Science as 'Ideology'." In Toward a Rational Society. Boston: Beacon Press, 1970.

———. The Theory of Communicative Action: Lifeworld and System. Translated by Thomas McCarthy. Vol. 2. Boston, MA: Beacon Press, 1987.

———. The Theory of Communicative Action: Reason and the Rationalization of Society. Translated by Thomas McCarthy. Vol. 1. Boston, MA: Beacon Press, 1987.

Parfit, Derek. Reasons and Persons. Oxford: Oxford University Press, 1986.

Simon, Herbert. "A Behavioral Model of Rational Choice." In Models of Man, Social and Rational: Mathematical Essays on Rational Human Behavior in a Social Setting, edited by H.A. Simon. New York: Wiley, 1957.

WORKSHOP COMMENTS

by Johan Hedrén

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Please find below some very short comments on the questions sent out to us all. I was hoping to have some more time to prepare and focus on these themes, as it was quite some time since I was engaged in the science-politics research area. Heading the options of providing no written comments at all and being extremely brief I decided to at least comment on the specific questions.

WHY SHOULD SCIENCE BE LINKED TO SOCIAL BENEFITS?

I would say that the striving towards societal benefits should be the tenet of research generally. But then, of course, we must also accept that the span between instrumental problem solving and projects aiming at a general understanding of broad fields, including basically critical investigations, is huge. Still both types of research can, and should be, motivated by the gaining of societal benefits. And there are, of course, very different kinds of societal benefits. Some might be in accordance with the interests of all citizens, while others both supports and clashes with values in society. And there seem to be a strong tendency in the realm of environmental research and climate change research to neglect the fact that quite many "identified" goals are biased by the interests of people with decent or good resources. The tradition of environmental justice theory and research is not very old, but still only rarely a strong voice in the setting of research agendas.

WHEN DOES IT MAKE SENSE TO LINK SCIENCE TO SOCIETAL BENEFITS?

In accordance with the standpoint taken on the first question, the short answer is always. But the crucial matter is how societal benefits are spelled out. It might be important to distinguish between frameworks based on conflict theory and frameworks based on theories of consensus. I would say that within the latter ones it is more common to think of science and politics as separate, while in the tradition of conflict theory they tend to be regarded as linked, both practically and theoretically. The critical tradition from Nietzsche, Adorno, Foucault and others, have clearly demonstrated how the power of modern politics, including its administration, is founded on the status of science as truthteller. A frequent recognition of social conflicts can be a sound and effective way to ponder on in whose interest that science speaks, and which values and interests it represents or counteracts.

HOW TO BEST LINK SCIENCE TO SOCIETAL BENEFITS?

By providing a structure of pluralistic research agendas and a culture of diversity within the field of science. By accepting that some issues fit a certain kind of design and cooperation, while others corresponds to different settings.

WORKSHOP COMMENTS

by Mark Howden

CSIRO Climate Adaptation Flagship

WHY SCIENCE SHOULD BE LINKED TO SOCIETAL BENEFITS:

There seem to be different rationales with different cultures. For example, in my experience in some nations science is seen almost as a statement of national identity, in others as a fundamental of economic 'progress' and in yet others as largely a cultural activity, somewhat divorced from the broader set of social goals. Whilst these are clearly 'cartoon-like' descriptions, the norms that they represent mean that the rationale for investment in science has quite different start and end points in terms of societal benefits. In Australia, we tend to have a fairly pragmatic view of science which has led to institutional arrangements where there is frequently an expectation of societal benefits stemming from science. One of the consequences of this is a tension between the stated institutional goals or mandates and the goals of individuals who try to maximise their own options in reference to some of the other operational norms to give career flexibility and advancement.

My experience is that even in heavily science-oriented issues, science is only a small part of the final decision-making processes. Politics, various policy constraints and economic aspects often take precedence and science per se is a minor contributor. If this is a general result, then we should not beat up on ourselves about linkages that are not crystal clear and direct.

WHEN IT MAKES SENSE TO LINK SCIENCE TO SOCIETAL BENEFITS

Much science in the domains I work in appears to at least attempt to appear to deliver on societal benefits even if that is not a deeply held commitment. Clearly, much of the activity falls short of the stated benefits partly because there was no real commitment to this in the first place, partly as there is always some failure rate in risky enterprises and some of it (especially more 'basic' science) may deliver on time-frames that are challenging to assess. The real problematic situations for me are those that fit the first category - essentially 'rent-seeking' behaviour that knowingly misdirects scarce resources in ways that reduce overall benefit. A clear pathway here is to develop more informed purchasers of science who have enough experience in different domains to make effective judgements.

HOW TO BEST LINK SCIENCE TO SOCIETAL BENEFITS

Particularly with longer-term issues, there is a tendency to opt for assessments of outputs (e.g. journal papers) rather than outcomes. This is a classic case of measuring what is easiest rather than what is most relevant. In its extreme forms, this converges to assessing inputs - typically dollars spent on R&D and societal benefit tends to disappear from the equation. Generally, aligning performance measurement to a more outcomes focus (accepting the challenges in doing that) will tend to result in a flow-on alignment of a whole range of factors towards societal benefit. Amongst many other factors, a stronger focus on developing the pathway to adoption from the outset and budgetting significant resources towards engagement throughout the process are also likely to result in better links. The latter in particular is effective if the decision-makers have some ownership of the process and contribute knowledge to it. However, traditional reductionist and unconnected science providers will likely see such activities as 'not science' and not contributing to their personal career development. One response here is to align better the various reward systems and to more clearly identify the characteristics of the people in organisations who can both deliver robust, multi-disciplinary science and effective, decision-relevant science. These 'bridging' or 'boundary-spanning' people seem to be rare and for various reasons are often marginalised in 'big science' domains.

PARTICIPATORY RESEARCH IN THEORY AND PRACTICE: WHY, HOW AND WHEN?[1]

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INTRODUCTION

The relationship between science and society has been widely debated in recent years. In an age of food scares such as the mad cow crisis in the UK or global environmental risks such as climate change, scholars and practitioners alike have suggested that scientific experts need to test the validity of their knowledge claims outside the laboratory. Rather than approaching the world of science as separate from society, there is today an extensive literature that seeks to hold science accountable to its public constituencies. Post-normal science (Funtowicz and Ravetz 1993), citizen science (Irwin 1994), Mode 2 science (Gibbons et al. 1994) and co-production (Jasanoff 2004, Lemos and Morehouse 2005) are just some of the many concepts currently employed to rethink the role of science in society. Central to all these concepts is the idea that science cannot function in isolation. Instead of building the scientific claim to authority on its presumed autonomy from societal context, a growing scholarship today seeks to make science more "socially robust" (Nowotny et al. 2002) through direct engagement with societal context.

In this chapter we discuss these scholarly efforts to establish a new social contract for science from the vantage point of two participatory research projects designed and implemented by researchers at the CSPR. The first project called DEMO (Participatory Catchment Modelling of Nutrient Transport for Sustainable Water Manage¬ment) was carried out in collaboration with the Swedish Meteorological and Hydrological Institute (SMHI) and the Lund University Centre for Sustainability Studies (LUCSUS) during the years 2005-2007. In this project the research team tested a participatory methodology in the drainage area of the Kaggebo Bay in the Baltic Sea in South-eastern Sweden. The project aimed to assess how mathematical models can be used in stakeholder dialogues with emphasis on reduction of nitrogen and phosphorus loads in local lakes and the coastal zone. The second project called PAMO (Participatory Modelling for Assessment of Climate Change Impacts on Water Resources) is still ongoing in the Thukela River Basin in South Africa. The project, developed in cooperation between SMHI and the University of KwaZulu Natal, aims to assess how various stakeholders perceive climate induced risks on water allocation, farming and the environment, and with what means adaptation to such risks can be met.

The chapter draws upon these practical efforts to engage stakeholders in the research process to critically assess contemporary calls for more "socially robust science". We use the term "participatory research" to denote the range of methods and techniques used by scientists to invite lay and stakeholder groups to articulate their knowl¬edge, preferences and values in relation to the issues at stake (e.g. focus groups, stakeholder dia¬logues, model facilitated dialogues and tool development workshops). Hence, rather than referring to an academic analysis of participatory processes in society, participatory research is here approached as an example of Mode 2 science co-produced in "the context of application" (Gibbons et al. 1994). The role of the stakeholder participants in the process is not to be observed, but to actively contribute to the conclusions. Following the experiences of DEMO and PAMO, we pay particular attention to participatory research organised around mathematical models. In both projects such models have been used as a platform for

1. This chapter appears in the CSPR report; Lövbrand, E., Linnér, B-O and Ostwald, M. (eds.) (2009). ***Climate Science and Policy Research. Conceptual and Methodological Challenges***, CSPR Report N:o 09:03, Centre for Climate Science and Policy Research, Norrköping, Sweden.

communication among different stake¬holder groups and scientists. Model facilitated dialogues, as defined in this chapter, thus implies modelling ***with*** people, in contrast to agent based modelling which is based on modelling ***of*** peoples' behaviour and its consequences (Pahl-Wostl 2002).

We organise our chapter around three central questions. Firstly, we ask ***why*** stakeholder groups should be involved in matters of science. Drawing upon the rich literature in this field, we identify a substantive and a normative rationale for participatory research. In the second section we make use of examples from the DEMO and PAMO projects to discuss ***how*** these theoretical imperatives can be translated into practice. We note that efforts to ***do*** participatory research are fraught by many practical constraints and contingencies. While the two projects have been informed by both substantive and normative aims, they raise the question to what extent it is possible to realise the high theoretical expectations tied to participatory research. Hence, we end by asking ***when*** participatory research makes sense. Although the ambition to open up science to public scrutiny and debate remains an attractive ideal, we note that meaningful stakeholder involvement in matters of science is a challenging and time consuming task (for researchers as well as for the invited stakeholders) that requires further scholarly scrutiny and debate.

WHY DO PARTICIPATORY RESEARCH?

Despite the recent celebration of public and stakeholder involvement in the production and use of scientific knowledge, a quick review of the literature in this field suggests that the debate is marred by murkiness (Kleinmann 2000). The lack of clarity is partly related to the range of different rationales for doing participatory research. In an attempt to map the debate, Stirling (2008) has made a useful distinction between substantive and normative imperatives. The substantive rationale for participatory research is primarily focused on outcomes. From this perspective, the involvement of representatives from various sectors of the society in the research process is approached as a means to broaden and enrich the knowledge base in a given issue area. Particularly in cases of high uncertainty or risk (e.g. anthropogenic climate change, biotechnology), the diverse "knowledge-abilities" of lay and stakeholder groups have been highlighted as a resource that will enhance the scope and quality of scientific risk assessment (cf. Funtowicz and Ravetz 1993, Felt and Wynne 2007). By creating conditions for meaningful deliberation on the unknown, unspecified and indeterminate aspects of scientific and technological development, participatory exercises are in this case thought to bring reflexivity to modern risk governance and thus increase society's ability to deal with unforeseeable contexts (Nowotny et al. 2002, p. 167).

While analytically distinct, this substantive argument for public or stakeholder involvement in the production and use of science is often closely tied to the normative imperative. The normative imperative can be interpreted as critique of the use of science in society. Rather than working for the benefit of society as a whole, scholars of science and society have argued that science too often serves an ideological function of legitimising the interests and decisions of societal elites (Fischer 2005, Wynne 2007). From this vantage point participatory research is promoted in the name of democracy and the empowerment of people as citizens (Irwin 1994, Leach et al. 2007). If members of the public are invited to question how experts frame an issue and thus "open up" unexplained assumptions and tactic value choices, they may, it is argued, challenge science-based claims made by social elites and hence build more legitimate forms of political authority (Stirling 2008, Fischer 2005). Beyond this broader ambition to enhance the democratic quality of public decision processes, the normative imperative also holds the promise of increased public acceptance of scientific knowledge. If social actors directly affected by research results are invited to validate the assumptions made in the various steps of a research process, it is assumed that they will gain trust in the findings (Andersson et al. 2008).

The DEMO and PAMO projects draw upon both these imperatives. While placed in different geographical and social contexts, the two projects have been designed to include stakeholder groups in the setup and use of natural science modelling tools. On the substantive side, such "co-production of knowledge" is expected to be beneficial to model development and application. By integrating stakeholders' perspectives in the research process, the projects have sought to enrich the understanding of environmental risks (eutrophication in the DEMO case, climate impacts on water resources in the PAMO case), and the range of societal obstacles that challenge the management of such risks. On the normative side, the involvement of affected social groups has aimed at increasing stakeholder confidence and ownership of the results and conclusions from the projects, including the formulation and dissemination of local adaptation and/or mitigation plans. In the following section we discuss how the DEMO and PAMO projects have translated these substantive and normative ambitions into practice.

HOW TO DO PARTICIPATORY RESEARCH?

The substantive and normative promise of participatory research rests upon a number of procedural requirements. Below we highlight three procedural aspects of relevance to the participatory quality and substantive output of the DEMO and PAMO projects; 1) the selection of participants, 2) the framing of the issues at stake, and 3) the design and implementation of the process (Jonsson and Alkan-Olsson 2005, Andersson et al. 2006).

Participant selection

The selection of participants is of central importance to any participatory research process. Depending on the aim and scope of the exercise, the participants can either be members of a specific civic constituency, representatives of organised interests (i.e. stakeholders), or experts with academic or non-academic training. Following their substantive rationale, the DEMO and PAMO projects have targeted affected stakeholder groups that are expected to add important knowledge to the research process. The DEMO project came about upon the initiative of local stakeholders within the agricultural sector, more specifically, a local branch of the Federation of Swedish Farmers, LRF, and particularly one enthusiast, in the Kaggebo region. This circumstance facilitated the stakeholder selection process and allowed the participatory modelling process to gain legitimacy by linking into local networks at an early stage. However, whereas the farmers involved in the process were part of a well-developed national farmers' network and therefore emerged as a strong stakeholder group, house owners with private sewages were less organized and therefore required more efforts to reach, motivate and engage.

In contrast to the DEMO experience, the PAMO project was not initiated by local stakeholders but by foreign researchers seeking to test a predefined research agenda in a new country context. The Swedish research team identified, in collaboration with their South African colleagues, three central stakeholder groups for which separate workshops were arranged, (i) government authorities; research in¬stitutes; and com¬panies; (ii) commer¬cial farmers; and (iii) small-scale farm¬ers. In a heterogeneous society such as South Africa, with large asymmetries in income, educational level, landownership and race, there are fundamental differences in how environmental risks and water allocation problems affect rich and poor. Although the main opportunity for a better future lies in cooperation between these various social groups, the asymmetries in wealth and voice made it difficult for the PAMO project to initiate a discussion about climate change in meetings with all groups participating.

However, also in the PAMO project the research team managed to involve a local enthusiast who helped to overcome the historical mistrust among the involved stakeholders. Working as a well-know and respected agricultural extension officer, this key actor facilitated the participation of small-scale farmers. He also functioned as a bridge between the local farming community, the commercial farmers and the representatives from local authorities. Consequently, both DEMO and PAMO demonstrate the trust and confidence building role that local enthusiasts or "fire souls" (Blomqvist, 2004) can play in participatory research.

Issue framing

The DEMO and PAMO experiences also suggest that the framing of the issues at stake is of great importance. When setting up computer-based models of environmental conditions, substantial amounts of information about landscape characteristics, human activities and observed variability of climatological and hydrological/oceanographic variables are needed. Earlier experiences (Alkan-Olsson and Berg 2005, Brandt et al. 2007) have shown that models used for the national scale (e.g., for national reporting) can use standardised input data such as soil type, vegetation, topography and climatic regions. However, when applying models to local conditions (where mitigation/adaptation measures are carried out), the quality of such standardised data increases significantly when verified locally. Hence, in the DEMO project, stakeholders were invited to perform such verification in the model setup. At this early stage of the research process, farmers provided data from soil sampling at the farm level and identified "typical management practices" at various types of farms. The stakeholders also participated in the monitoring of water levels and sampling of water for nutrient analyses, verified official databases and included "soft data" (e.g. observations of overland flow or of flow in macropores).

The substantive value of this stakeholder input was demonstrated at an early stage of the project when the participants noted that the hydrological boundaries, as shown on official maps, had been altered with the consequence that a substantial amount of riverine water did not reach the coastal zone in focus for the project. Had the incorporation of this knowledge not been considered in the model setup, the results may have been seriously questioned and the overall confidence in presented results low. Thus, in the DEMO case, stakeholder participation led to a better model description of reality due to inclusion of local information, as well as improved possibilities for model calibration and validation.

In the PAMO project, however, there was no stakeholder involvement in the actual setup of the climatological and hydrological models. Instead of inviting the stakeholders to provide descriptions of current hydrological conditions and possible impacts on these by local actions, the aim of the model exercise was to provide information about projections of relative change of climate-related conditions deemed important by the stakeholders. To that end the PAMO researchers asked the stakeholder participants to select what projections to provide and to respond to the three climate impact scenarios provided. The issue of climate change scenarios was explained by the researchers at an early stage of the project and it was made clear to all participants that the scenarios represented thinkable pathways to future development, not predictions. On the basis of this discussion, the participants were invited to assess the robustness of the three provided climate change scenarios, produced with different combinations of Global Circulation Models and emission scenarios.

Although guided by a substantive rationale, the researches did not have time enough to include the rainfall and temperature data collected by the farmers in the area in the setup of the hydrological model for the area. This demonstrates that sometimes compromises have to be done, where the degree of participation has to be limited in order not to slow down the process too much. Since climate change scenarios containe a great deal of uncertainty and since many participants need to focus on today's problems rather than on planning for the future, the researchers let the participants address their ***present*** vulnerability to impacts of climate variability. This exercise helped the researchers to better adjust their climate scenarios to local needs. In addition, exercises were included to assess the participants' overall fears and visions for the future. Consequently, the framing of the project over time shifted from a strict focus on climate change, to issues of more relevance to the participating stakeholders.

Project design and implementation

The design of a participatory process represents the third procedural aspect of importance for participatory research. Davies and Burgess (2004, p. 352) observe that participatory exercises rests upon messy and socially embedded encounters in which a complex series of judgements are negotiated around the knowledge and identities of all involved actors. To structure such processes in accordance with procedural ideals is a methodological challenge that draws attention to participatory researchers themselves. Practical choices made by this emerging epistemic community (Chilvers 2008) shape the dynamics of the exercise in a manner that affects its normative and substantive potential.

The DEMO and PAMO experiences suggest that practicalities such as meeting venue, time during of the day and year, food and drink for the participants affect the willingness of the targeted stakeholder groups to participate in the exercise. To organise meetings in locations familiar to the participants is also of importance, not the least because it gives the project scientists the role of guests rather than hosts of the meetings. This change of roles affects the power dynamics of the exercise and facilitates local trust building. In the DEMO and PAMO cases, the scientists started off the process with lectures containing facts on the issues at stake. These lectures ensured that all participants received a shard understanding of eutrophication (in the DEMO case) and climate change impacts on water resources (in the PAMO case). Gradually, however, a dif¬ferent division of roles between researchers and local stakeholders developed. Lively discussions took place and several types of knowledge surfaced, i.e. both expert and local. This more open-ended type of deliberation allowed the participants to develop "interactional expertise" (Carolan 2006) that enhanced the co-production process substantially.

Although the DEMO and the PAMO experiences differ, they both suggest a transformed role for the research team. Rather than acting as a distant provider of information, the DEMO and the PAMO researchers turned into equal participants in the process of compiling a picture of environmental conditions today and possible scenarios for the future. As argued by Schulze (2001) the use of models as a policy-making tool makes it necessary for scientists to shift from a "research thinking" to a more outcome based "policy thinking" to fit the needs and demands of stakeholder groups involved in a research process where policy is in focus. However, far from all participatory research projects result in this transformation. The DEMO and the PAMO projects suggest that the number of meetings organised is one central factor that affect the trust and confidence building potential of the exercise.

In the DEMO case the stakeholders were invited to participate in the research process in three phases. After having given significant input to the model setup, the stakeholders were also asked to present their local "water visions", i.e. desirable services from lakes and the coastal zone translated into desirable levels of nutrient concentrations optimal for these services. These locally formulated goals, in combination with the EU Water Framework Directive (WFD) and the Swedish national environmental quality objectives, then fenced the discussion on how much reductions of nutrient levels that were needed (Andersson et al. 2008; Jonsson et al., in prep.). The invited stakeholders also contributed to the identification of obstacles for the implementation of suggested mitigation measures. During the DEMO meetings, the involved groups got to know each other well which contributed to a high degree of perceived ownership of the process and the final project report. Since PAMO is not yet finalized, it is too early to draw any final conclusions about the quality of the participatory process. However, the lower number of meetings is likely to be one of several factors that will lead to a less pronounced perception of ownership from the involved stakeholder groups. Considering the complex socio-economic setting of the project area and the researchers' foreign passports, it can be questioned, however, if it at all is possible to obtain the same degree of stakeholder engagement in the PAMO project.

WHEN DOES PARTICIPATORY RESEARCH MAKE SENSE?

In this brief paper we have discussed findings from two participatory modelling projects carried out in Sweden and South Africa. Both research projects have taken place in parallel to local policy making, although the institutional framework for actually ensuring that the research-driven process has a real impact on local policy is rather vague. Driven by both substantive and normative ambitions, the projects have sought to create a consensus among local stakeholders around the nutrient pollution problem and possible ways forward in the Kaggebo Bay and its drainage area, as well as around the climate change and water resources issue and possible ways to adapt in the upper Thukela basin in South Africa. The extents to which these ambitions have been met vary in the two projects. In the DEMO case the input from local stakeholders was substantial, resulting in a high degree of confidence and trust in the project results. Most stakeholders concluded that it was the process in itself, including dialogues with external experts, people in their own sector, as well as other local groups with other perspectives, that influenced their understandings and possible future action. The scientific models as such were only useful to the extent that they were included in these dialogues.

The socio-economic complexity of the PAMO project has resulted in a different project dynamics. While it is too early to determine the final results from this South-African experience, it remains clear that successful participatory research requires substantial investments in time and trust. The issue at stake must be seen as meaningful by all those involved, and a fair balance needs to be found between science and stakeholder influence. As demonstrated by the DEMO and PAMO experiences, projects initiated locally by the involved stakeholders seem to have better potential to realise their substantive and normative promise than projects with a scientific bias. Moreover, projects with a high degree of stakeholder input and many project meetings are likely to gain more trust among the involved participants, than projects organised around a pre-determined scientific agenda. However, meaningful involvement is seldom straightforward. No matter how much resources that are spent on process design, a risk always remains that powerful groups, whether experts or dominant stakeholders, "highjack" the process. Rather than opening up the issues at stake to scrutiny and debate, such participatory exercises may instead legitimise the interests and agendas of the few at the expense of the many (Stirling 2008, p. 278). To reduce this risk requires a great deal of awareness and motivation within the research team.

Beyond these procedural challenges, meaningful involvement is also closely tied to the substantive outcome of the exercise. As noted by Abelson et al. (2005), the willingness of non-scientific actors to invest time and resources into participatory exercises often hinges on their ability to make a difference and have real policy impact. While both DEMO and PAMO have tapped into pressing environmental policy issues, the direct influence of the research process over political decision making will always be limited. In order to secure a continued social interest in participatory research, we conclude that involved scientists have to reflect upon their role and specify where the research process ends and policymaking begins. They also have to strike a balance between the willingness among various stakeholder groups to engage in participation, and the value such engagement adds to the research process. Since participatory research is a challenging task that requires a great deal of commitment by all involved actors, it does not fit for every purpose. Hence, before embarking on time consuming participatory exercises, we conclude that scholars need to take careful note of the circumstances when and how they add value to the research process.

REFERENCES

Alkan-Olsson, J. and Berg, K. (2005), 'Local stakeholders' acceptance of model-generated data used as a communication tool in water management – The Rönneå study', AMBIO, 7, 507-512.

Andersson, L., Jonsson, A., Alkan Olsson, J., and Arheimer, B. (2006), 'Participatory Modelling as a Tool for Public Participation in Water Resource Management, in J.C. Refsgaard and A.L. Höjberg (eds), Proceedings of the XXIV Nordic Hydrological Conference 2006, NHP Report No. 49, 226-233.

Andersson, L., Wilk, J., Warburton, M. and Graham, P. (forthcoming), 'Use of participatory modelling to assess risks and adaptation strategies to cope with climate change impacts on water resource in the Thukela river basin, South Africa', manuscript for submission to Climate Change during 2009.

Andersson, L., Alkan Olsson, J, Arheimer, B, and Jonsson, A. (2008), 'Use of participatory scenario modelling as a platform in stakeholder dialogues', Water SA 34(3), HELP Special Edition.

Blomqvist, A. (2004), 'How can stakeholder participation improve European watershed management? The water framework directive, watercourse groups and Swedish contributions to Baltic sea eutrophication', Water Policy 6, 39-52.

Brandt, M., Arheimer, B., and Andersson, L. (2007), 'Catchment modeling for quantification of Swedish nutrient transport to the sea and effects of measures', in Schumann, A. and Pahlow, M. (eds), Reducing the Vulnerability of Societies to Water Related Risks at the Basin Scale. IAHS Publication 317, 84-89.

Carolan, M. S. (2006), 'Sustainable agriculture, science and the co-production of "expert knowledge": the value of interactional expertise', Local Environment, 11, 421-431.

Fischer, F. (2005), Citizens, Experts, and the Environment. Durham and London, Duke University Press.

Funtowicz, S.O. and Ravetz, J.R. (1993), 'Science for the post-normal age', Futures 25(10), 739-755.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. and Trow, M. (1995), The New Production of Knowledge. The Dynamics of Science and Research in Contemporary Societies, London, Thousand Oaks and New Delhi, Sage Publications.

Irwin, A. (1995), Citizen Science: A Study of People, Expertise and Sustainable Development. London and New York, Routledge.

Jasanoff, S. (2004), States of Knowledge. The Co-Production of Science and Social Order. London and New York, Routledge.

Johansson, M., (2008). Barriärer och Broar. Kommunikativa Villkor I det Svenska Miljömålsarbetet. Linköping studies in arts and science, No. 469, Linköpings universitet, Sweden.

Jonsson, A., Andersson, L., Alkan Olsson, J. and Arheimer, B. (2007), 'How participatory can participatory modeling be? A discussion of the degree of influence and stakeholder and expert perspectives in six dimensions of participatory modeling', Water Science and Technology 56, 207-214.

Kleinmann, D. L. (2001), 'Democratizations of Science and Technology', in D Kleinmann (ed), Science, Technology and Democracy, Albany, State University of New York Press.

Leach, M., I. Scoones, and B. Wynne (2007), Science and Citizens: Globalization and the Challenge of Engagement. London and New York, Zed Books.

Lemos, M.C. and Morehouse, B.J. 2005. 'The co-production of science and policy in integrated assessments', Global Environmental Change 15: 57-68.

Nowotny, H., Scott, P. and Gibbons, M. (2002). Re-thinking Science. Knowledge and the Public in an Age of Uncertainty, Polity Press, Cambridge.

Pahl-Wostl, C. (2002), 'Towards sustainability in the water sector – The importance of human actors and processes of social learning', Aquatic Sciences 64, 394-441.

Schulze, R.E. (2001), 'Managing Water as a Resource in Africa: Are we Asking the Right Questions?', in Gash, J.H.C., Odada, E.O., Oyebande, L. and Schulze, R.E. (eds), Freshwater Resources in Africa, Potsdam; BAHC International Project Office.

Stirling, A. (2008), "Opening up' and 'closing down': Power, participation, and pluralism in the social appraisal of technology', Science, Technology and Human Values 33(2), 262-294.

A MIND EXERCISE

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"Too long, the Earth has been a madhouse!"
F. Nietzsche

INTRODUCTION

Since the last lecture on the theory of science in 2008 it has puzzled me why did Sven Ove Hansson quote Nietzsche in the last chapter of his paper titled "The Art of Doing Science" (2007, p. 89)? Not only that has bothered me for so long, but also how should Nietzsche's words be understood in the perspective of this elaboration on doing science and whether its author misinterpreted rather enigmatic thoughts of the philosopher. But what perhaps has interested me the most is the meaning of Nietzsche's quote in a broader picture, outside of "The Art of Doing Science" context. Therefore, I do not intend to focus entirely on argumentation with Hansson's ideas regarding (objective) science. Rather, I prefer to explore the meaning of the quote itself because it requires me to dig into Nietzsche's philosophy – a refreshing mind exercise, even though very strenuous at times. The quote that is taken partially by Hansson from Nietzsche's "On the Genealogy of Morals" goes like this:

> "Isn't it the case that since Copernicus the self-diminution of human beings and their will to self-diminution have made inexorable progress? Alas, the faith in their dignity, their uniqueness, their irreplaceable position in the chain of being has gone. The human being has become an animal, not a metaphorical animal, but absolutely and unconditionally—the one who in his earlier faith was almost God… All scientific knowledge … is nowadays keen to talk human beings out of the respect they used to have for themselves, as if that was nothing more than a bizarre arrogance about themselves." (quoted in: Hansson, 2007, p. 89)

Certainly, the discovery of Copernicus had a fundamental meaning for the human history and thus was marked as the beginning of the modern science (Gribbin, 2003; Harries, 2002; Shapin, 1998). Even for us - living in the 21st century - it is difficult, even impossible, to imagine how profound impact the new Copernican system had on people's thoughts and understanding of the world at that time. He stopped the Sun and moved the Earth - an extraordinary change of the outlook, and even today the thought of a planet that floats as some sort of a ship in space is overwhelming because the movement cannot be really sensed by us when we stand on the firm ground below the abyss of the sky. Additionally, the Copernican system was a punch towards the doctrine of the Judeo-Christian ideology, even though the Church had consequently ignored Copernicus' work until it was politicized by Giordano Bruno who pursued to establish a heretic cult called Hermetism as true religion (Gribbin, 2003, pp. 17-19; Harries, 2002, pp. 242-263). The elevation of the Sun-cantered model to a system of beliefs made a critical impact on the Holly Land's relation to science and scientists, including Galileo who was one of the first victims of this shift (Gribbin, 2003, pp. 98-103).

However, the most interesting thing is that Copernicus himself was far from being a so called scientist of the modern world since his explanation was not really based on a series of experiments or observations. On the contrary, his model of the Universe was more of an idea based on the contribution of previous thinkers and on the reasoning that the proposition of the new system would look more elegant and logical then the previous one (Gribbin, 2003, pp. 4-15). And where Hansson comments the quote from Nietzsche in the last chapter of his paper by stating that we should not reject ***"science for its lack of anthropocentrism"*** (2007, p. 89), in my opinion he fails to understand the message of the philosopher for whom the modern science was above all anthropocentric[1]. Yes, Copernicus moved the Earth and stopped the Sun. By doing so our position in the Universe changed dramatically, and in result we were, metaphorically speaking, no longer in the centre of God's world. But Copernicus did so by interpreting the reality through his reason since he did not have any other choice because, to use Nietzsche's words, ***"we see all things by means of our human head and cannot chop it off; though it remains to wonder what would be left of the world if indeed it had been cut off"*** (Nietzsche, 1996, p. 17). And when Nietzsche writes that ***"the human being has become an animal, not a metaphorical animal, but absolutely and unconditionally—the one who in his earlier faith was almost God"***, he does not mean that by removing ourselves from the highest pedestal we somehow became less anthropocentric, particularly in our scientific aspirations. His thoughts condensed within this single quote express a much more complex and deeper meaning than, I think, Hansson expects. In my opinion, the misunderstanding and misplacement of Nietzsche's words in "The Art of Doing Science" is a result of Hansson's entirely different approach to science than what the philosopher proposed.

THE REAL AND THE APPARENT WORLD

It is, understandably, impossible to explore all dimensions of Nietzsche's thoughts and reflections in my essay. Additionally, scholars differ on how to understand many details of the philosopher's remarks about "truth", "knowledge" and "reality", etc. However, I will try to present important aspects of Nietzsche's philosophy of science in connection to what Hansson proposes in his paper.

In general, Nietzsche's ***perspectivialism***[2] stands in opposition to positivist approaches and claims that self-sufficient facts cannot be found in reality (Babich, 1994, p. 39). As Nietzsche challenges, ***"(...) a real world - whatever it may be like - we certainly have no organ for knowing it."*** (Nietzsche, 1968, 583), and ***"'truth' is therefore not something there, that might be found or discovered - but something that must be created (...)"*** (Nietzsche, 1968, 552). In other words, for Nietzsche the scientific world, with all its achievements and discoveries, is a human construction. He considers science ***"as an attempt to humanize things as faithfully as possible; as we describe things and their one after another, we learn to describe ourselves more and more precisely."*** (Nietzsche, 1974, 112).

Whereas for Nietzsche objective scientific truth is illusionary , Hansson seems to represent an entirely different view on science, and I doubt that it could be possible to find any commonalities between both outlooks. According to Hansson, science aims ***"to obtain knowledge about how things really are"*** [4], and ***"this means that we are striving for objective knowledge"***. (2007, p. 11). He concludes that ***"science is devoted***[5] ***to finding out how things really are."*** and then mentions three presuppositions on which since is based: ***"1 There is a real world that is independent of our senses. 2 This real world is common to all of us. 3 With combined forces we can achieve, or at least approach, knowledge about this real world that is common to us all."*** (2007, p. 11).

A real world that is independent of our senses but at the same time is also common to all of us –

1. Additionally to the suggestion that we should not reject science for its lack of anthropocentrism, Hansson distinguishes between ***descriptive*** and ***ethical*** anthropocentrism, where the latter could also be called ***humanism***. Since, according to Nietzsche's line of thought, (descriptive) science or ethics are essentially anthropocentric, because they are our interpretations of the world around us, the proposed ***ethical anthropocentrism*** simply sounds like a pleonasm (e.g.: black darkness, burning fire, cold ice).

2. I will borrow this term from Babette E. Babich, who intends to distinguish Nietzsche's unique "perspectivism" from "relativism" (1994, p. 46-57).

3. And whereas Richard Dawkins writes about "The God Delusion" (Dawkins, 2007), one could contrarily ask about his "Darwinian Illusion".

4. One could ask teasingly: how things really ***are*** according to ***whom***?

5. This underline is not to be found in an original quote. I will underline some parts of the quotes throughout this paper to put stress on words and phrases that I personally find important to emphasize.

thus, I wonder whether we should all together chop our heads off in order to reach for the universal "truth". ***"Why does man not see things?"*** Nietzsche asks and provides a straight answer: ***"He is himself standing in the way: he conceals things."*** (Nietzsche, 1982, 483). We create the "real" word through our mind and senses, and we make it common to all of us. We do not just apply explanations to the world, what Hansson suggests in his elaboration on the art of science (2007, p. 89), but we essentially create explanations and interpretations of our "real" world. ***"We have arranged for ourselves a world in which we can live - by assuming bodies, lines, surfaces, causes and effects, motion and rest, shape and content; without these articles of faith nobody would now be able to endure life! But that does not mean that anything has yet been proven. Life is no argument. For error might be one of the conditions of life."*** (Nietzsche, 1974, 121).

THROUGH OBJECTIVITY TO SALVATION

Let me go back, then, to Nietzsche's quote that Hansson used in his paper on "The Art of Doing Science". In my opinion, on the very general surface Nietzsche's sentiments expressed in the quote can be understood within a three-dimensional perspective.

First, due to its presupposition that "truth" ***is – as "the highest authority itself, because truth was not allowed to be problematic"*** (Nietzsche, 2009, III:24) - modern science made us even more ignorant about the world (and about ourselves as well). An extreme, probably infinite, richness of diversity, complexity and uniqueness of the Nature[6] (whether it be leaves on the tree, or snowflakes that are never identical to each other[7]; the list of examples could go on) is negated by a scientific homogenization of reality, it is being squeezed, packed and wrapped by our scientific conduct. ***"It is we who created the "thing," the "identical thing," subject, attribute, activity, object, substance, form, after we had long pursued the process of making identical, coarse and simple. The world seems logical to us because we have made it logical."*** (Nietzsche, 1968, 521). In result, our anthropocentric, artificial world with perfect measures, shapes and designs has become more interesting, or perhaps some of us have just got used to it, whereas Nature is no more special to us, because in our view it has become... imperfect. This feeling is well portrayed by Oscar Wilde in "The Decay of Lying: An Observation": ***"But Nature is so uncomfortable. Grass is hard and lumpy and damp, and full of dreadful black insects (...) If Nature had been comfortable, mankind would never have invented architecture, and I prefer houses to the open air. In a house we all feel of the proper proportions (...) Whenever I am walking in the park here, I always feel that I am no more to her than the cattle that browse on the slope, or the burdock that blooms in the ditch. Nothing is more evident than that Nature hates Mind."*** (Wilde, 1889). And for Nietzsche this ***"bizarre arrogance"*** is expressed by humans in form of their anthropocentrism (Del Caro, 2004, p. 30), thus he charges that ***"(...) to demand that our human interpretations and values should be universal and perhaps constitutive values, is one of the hereditary madnesses of human pride".*** (Nietzsche, 1968, 565).

Second, as it was already mentioned above, according to Nietzsche we do not have a scientific tool or organ of perception to see the real world that would stand outside the box of our anthropocentric understanding. However, we still try to pursue the goal of perceiving the "truth" by using value-free and objective science. In her book on "Nietzche's Philosophy of Science" Babette E. Babich discusses this constraint: ***"As human beings we are caught in the prison of our own perceptual/conceptual***

6. When I am writing this fragment now, I am fully aware of my limited abilities to make a proper account of the phenomena. Even to describe Nature with a ***noun***, to imply that Nature is something ***static***, like some sort of a monument is, in my opinion, an example of this limitation.

7. Actually, in 1988 the ***scientist*** Nancy Knight found two ***identical*** snowflakes in a Wisconsin snowstorm. "Eureka!" one could shout. Yet, one has to silence the excitement, the two objects were ***identical under the microscope***, but not anymore on the ***molecular level***. Moreover, the snowflakes did not look like ***classical six-spiked star shapes*** but like (un-classical?) ***hollow hexagonal prisms***. Fortunately ***snowologists*** counted them as ***snowflakes***. Thus, we can feel relieved, science prevailed over nature again. The myth that all snowflakes are different is refuted! It only remains to wonder, whether I am the only one that finds it all slightly but tragicomically absurd…

http://www.abc.net.au/science/articles/2006/11/13/1784760.htm?site=science/greatmomentsinscience

construction, a projective horizon that in turn is determined by our eco-physiological needs and constraints. Although we cannot exceed our own projective, that is, already self-exceeding, interests (...), the project of objective knowledge (science) seeks a reality beyond what comes into appearance as such in its own project. One might think of science as in this way as a project of the project, or the project of epistemological excess." (1994, p. 148). Nietzsche's critique of "objective science" aims precisely to undermine the conviction that such science can lead to universally valid truths and, thus, he exposes science as only an interpretation that does not have access to such truths. For Nietzsche, the absolute vision of a universal "truth" is what made science become an old ascetic ideal – in form of the Christian religion, that he was vehemently opposed to – the one that was supposed to be demolished with the arrival of the Copernican revolution (Kaufmann, 1974; Babich, 1994). The problem with modern science, as Nietzsche writes, is that ***"it is still a metaphysical faith upon which our faith in science rests – that even we devotees of knowledge today, we godless ones and anti-metaphysicians, still take our fire, too, from the flame that a faith, thousand of years old, has kindled: that Christian faith, which was also the faith of Plato, that God is truth, that truth is divine."*** (Nietzsche, 1974, 344).

Third, the consequence of science resting on the same foundations as the ascetic ideal, ***"on the same overvaluing of the truth"*** (Nietzsche, 1925), is that science becomes trapped in the nexus between ***creation*** of the manufactured reality and ***salvation*** from this substitute world through liberation from the senses that supposedly leads to objectivity (Babich, Cohen, 1999, p. 160). In "Human, all too Human" Nietzsche writes that ***"(...) other people have gathered together all characteristic traits of our world of appearance (that is, our inherited idea of the world, spun out of intellectual errors) and, <u>instead of accusing the intellect</u>, have attacked the essence of things for causing this real, very uncanny character of the world, and have preached salvation from <u>being</u>."*** (Nietzsche, 1996, p. 24). In other words, instead of to be here and now, there is always another reality that people prefer to aspire to - either it is an eternal afterlife in Christianity or universal truth in the modern science. However, the modern science, ***"that is an achievement of salvific culture, as the millenarian idol of Connolly's 'ontological narcissism[8]"***, as Babich interestingly observes, is vindicated by its factual efficiency (in form of technological achievements) and therefore ***"we see that 'salvation' is an indirect expression of scientific technology."*** (Babich, 1994, p. 197-199). To illustrate this statement, let me show two small examples of this scientific form of ***salvation***. First, take a look at the fragment from the text published in 1890: ***"But this we know: that wherever it is possible to benefit humankind, to alleviate suffering, to elevate humanity, and to rise man more nearly to the <u>true image</u> of his Maker, there the aid of natural science will never be found waiting."*** (Anonymous, 1890, p. 244). The author solemnly announces that natural science is prepared to aid, benefit, and elevate humanity, closer towards God. Ironically speaking, the creators of the Creator will use their creations to rise more nearly towards the Creator himself. In another quote, written exactly 100 years later, Hans Seigfried writes: ***"The objective representation of natural processes is no longer possible[9] (...) Physicists are no longer detached observers and spectators[10], nor 'prescriptive' dictators, but participants in a transaction (Wechselspiel) between man and nature shrouded by uncertainty relations (...) And only through such a transaction in all areas of life, as exemplified by the experimental performance of physicists, can we <u>really</u> have a say in the <u>making of the laws which determine our form of life</u> and <u>give ourselves laws at last</u> (...) Only the spirit of physics <u>can save us</u>."*** (Seigfried, 1990, p. 629). But save us from what, from not knowing the universal truth that will supposedly be reviled by the no-more-objective wisdom of quantum physics, by the "***anthropocentric language of pure knowing***"

8. ***"Ontological narcissism - as we might label views that demand dispensations from within the world to replace the loss of a personal, willful, and powerful God located above it - allows each of the contending parties to <u>domesticate the protean idea of contingency</u>: each of these orientations invokes ontological assumptions that domesticate contingency as the unexpected, the dangerous event, the obdurate condition that resists effective intervention, the inevitable outcome accidental only in its timing, the resistance to detailed design lodged in the human animal and nature. And perhaps each masks the conversion of a world of micro-contingencies into a world of global contingency by its insistence that <u>the world itself must be predisposed to us in one way or the other.</u>"*** (Connolly, 2002, p. 30)

9. Was this "***objective representation of natural processes***" possible before?

10. Was it possible for the physicists to be "***detached observers and spectators***" before?

(Del Caro, 2004, p. 99)? How can we save ourselves by creating (***"making", "giving ourselves"***) the laws which determine our created meaning of existence, over and over again? ***"'Why this suffering?' Man, the bravest animal, the one most accustomed to suffering, does not deny suffering in itself; he desires it; he seeks it out in person, provided that people show him a meaning for it, a purpose of suffering. The curse that earlier spread itself over men was not suffering but the senselessness of suffering – and the ascetic idea offered him a meaning! (***Nietzsche, 2009, III:28)

PROGRESS. - LET US NOT BE DECEIVED!

But the question remains still, how could Nietzsche's words on ***self-diminution of human beings*** and ***human being becoming an animal*** be understood? To approach a deeper level of Nietzsche's message in the quote one has to first understand that by living at the turn of the 19th and 20th centuries, Nietzsche was a first-hand witness of the unprecedented scientific, industrial and socio-economic revolution that took place in the Western world at that time. However, he was not an admirer of those changes. Most importantly, he did not share the faith and enthusiasms in Darwin's concept of "evolution" and that especially other scientists fully, or partially, accepted and applied it to their scientific projects (Call, 1998; Kaufmann, 1974).

Since Nietzsche understood that we could only strive for apparent interpretations of the world, because men do not posses a proper tool or organ too see the "truth" outside of their minds, he considered Darwin's ideas to be just another anthropocentric project carried out under human consciousness and subjectivity. Thus, it disturbed him that, in their ***ontological narcissism***, many thinkers and scientists applied Darwinism, or different aspects of it, to their "objective/universal" socio-economic concepts of human life and organization. Particularly Herbert Spencer's work was, for Nietzsche, the worst kind of the 19th century science. As Lewis Call explains, Spencer represented ***"a perfect example of the scientist who was so completely convinced of the objective truth of his theory that he was entirely unwilling to consider the possibility that this theory might be one possible interpretation among many."*** (1998, p. 4). According to Deleuze, Nietzsche was opposed to the social Darwinism, because when it comes to humans "***(...) Darwin confused struggle and selection. He failed to see that the result of struggle was the opposite of what he thought; that it does select, but it selects only the weak and assures their triumph."*** (quoted in: Del Caro, 2004, p. 342). Thus, when Spencer writes that ***"this survival of the fittest, implies multiplication of the fittest"*** (Spencer, 1864, Vol.I,III:7), Nietzsche contradicts this statement by saying that ***"wherever progress is to ensue, deviating natures are of greatest importance. Every progress of the whole must be preceded by a partial weakening. The strongest natures retain the type, the weaker ones help to advance it. Something similar also happens in the individual. (...) There is rarely a degeneration, a truncation, or even a vice or any physical or moral loss without an advantage somewhere else (...) To this extent, the famous theory of the survival of the fittest does not seem to me to be the only viewpoint from which to explain the progress of strengthening of a man or of a race."*** (Nietzsche, 1968, 224). In other words, Spencer's ***"multiplication of the fittest"*** was for Nietzsche a wrong way that would lead to the creation of ***"the lower species ("herd," "mass," "society")"*** (Nietzsche, 1968, 27), another anthropogenic simplification, but this time of ourselves, a self-diminution in all its glory!

"Making men smaller and more governable is desired as "progress"!" (Nietzsche, 1968, 129). The idea of inevitable, evolutionary development that humans ***en masse*** are required to impotently submit to, because there is no other way according to the "objective" science of scholars striving for an absolute truth (towards salvation through progress)[11], this ***"Fatalism, Darwinism"*** (Nietzsche, 1968, 69) and homogenization of men – ***"that each individual might become a useful tool and also feel like nothing more than this"*** (quoted in Call 1998, p. 17) - was something that Nietzsche could simply not accept. Furthermore, and what I think is perhaps more important, he understood that

11. ***"In this way a goal seems to have entered the development of mankind: at any rate, the belief in progress towards the ideal is the only form in which a goal in history is thought of today. In summa: one has transferred the arrival of the "kingdom of God" into the future, on earth, in human form--but fundamentally one has held fast to the belief in the old ideal."*** (Nietzsche, 1968, 339).

since we were the creators of our own "progress", there was also a danger that we could become enslaved by it. For Nietzsche, the idea of social Darwinism (of ***"herd values"***) to be elevated to the political sphere, especially in form of mass governing, was highly inadequate and promoted ***"a dangerously inaccurate view of human society and culture",*** that carried with it formidable political possibilities (Call, 1998). Thus, he shouts in despair: ***"Progress.— Let us not be deceived! Time marches forward; we'd like to believe that everything that is in it also marches forward—that the development is one that moves forward. The most level-headed are led astray by this illusion. (...) "Mankind" does not advance, it does not even exist (...) Man represents no progress over the animal (...)"***(Nietzsche, 1968, 90).

SCIENTIFIC UNCERTAINTY – A DOMESTICATED QUESTION MARK

It is interesting and at the same time provocative thou to scrutinize the science of climate change that, in the light of Nietzsche's ideas (which I, by the way, find far beyond the deepest ecology), appears to be only our interpretations of current events that take place around us. However, I will only shortly discuss the problem in this context since, here and now, when I am writing, I have this very ironic thought. That after reconstructing, redesigning, reshaping, repacking and rewrapping the world around us for the last hundreds of years (including the last one hundred when we domesticated this reality on an unprecedented scale), eventually we face a challenge of interpreting the consequences of our previous interpretations, particularly of a grand human project called ***progress***. And perhaps that is the reason why the science of climate change has become so controversial. Interestingly, that even in the face of the global cataclysm, the idea of reversing our socio-economic and technological development is most often taken out of the question. Instead, we strive to find another path for the continuation of the progress[12], a path to be still directed forward.

Moreover, the science of climate change goes even further than making interpretations of the present, because it tries to forecast events that might happen in the future, in the global scale. And whereas our interpretations about the Earth's current condition, as well as the forecasts based on interpretations (models) are circulating and spinning around in a heated scientific (as well as public) debate[13], they are at the same time being applied to the sphere of political decisions, or to, generally speaking, mass-governing (of "societies"). I do not intend to argue here that the problem of climate change does not exist or it does not need a solution of any kind. What I am trying to point out is that by transferring and applying these "objective" scientific interpretations (including various technological solutions) to the socio-economic and political levels, we can arrive at positive results but we can also face dangerous implications.

In one part of his paper Hansson elaborates that ***"the effects of science on our worldviews are unpredictable, if for no other reason because they depend on the unpredictable outcomes of scientific research", and furthermore, "the general trend of this impact is that it tends to remove ourselves from the central place that we previously had in our picture of the world we live in[14]***" (Hansson, 2007, 88-89). However, one should also ask here: what about the impact of our worldviews on science? Is it only that the effects of science can have the impact on our worldviews? For Nietzsche, "there is no science 'without presuppositions'." (Nietzsche, 2009, III:24) and the effects of our science are our subjective interpretations of the world. Thus, the impact of science on our worldviews cannot remove ourselves from the central place we occupy, because our worldviews have the impact on our science. If Hansson's worldview assumes that we strive for objective knowledge, that there is something like objective knowledge at all, it will definitely make impact on the way he interprets the reality (as objective), and he will think of his work as objective science. In other words, he

12. Most notably: ***sustainable development***;

13. No wonder that the whole debate on the problem of climate change is often reduced to absurdity, for example: when is it going to start, or has it already started? As if Nature was standing out there with a stopper.

14. I hear the bell-ring: narcissism knockouts ***modesty***;

occupies the very central place as the creator of his own worldviews that influence his scientific interpretations that influence his worldviews. Thus, there is no way he could actually remove himself from the central place that he has in his picture of the world he lives in, perhaps only if he stops thinking or dares to chop off his head. But why am I writing all this gibberish?

Because - in my opinion - through his critique of ***"the persistent, uncritical scientism of intellectual, sophisticated and critical culture"*** (Babich, Cohen, 1999, p. 3), Nietzsche tries to presents a holistic picture of dangerous implications of the situation when scientific interpretations, that particular scientist believe to be objective truths, are applied to the world, including the social construction of human life. Nietzsche shouts, but who listens?: ***"O, what nowadays does science not conceal! How much, at least, it is meant to conceal!"*** (Nietzsche, 2009, III:23). By applying "objective truths" into the world, while not acknowledging that they are only scattered images and subjective perspectives, we are unconsciously, in a vicious circle, (re)creating our truths, worldviews, knowledge and morality that, in result, strike us back in form of a conceptual seizure (through ***the will to power***)[15] of not only Nature itself, but also of ourselves – a reflection in a distorting mirror. Thus, instead of reaching the expected salvation[16] we actually end up, I would say, enslaved inside of an anthropogenic madhouse[17].

In conclusion, I would like to emphasize that I do not suggest we should idealize Nietzsche and take his ideas for granted, and definitely I do not imply that one is supposed to treat his thoughts as an absolute truth (I am not even sure if I was correctly interpreting many of his assumptions). I also regret that there was no space (or time) to discuss more of his ideas in the frames of this assignment, thus I had to omit a lot of important aspects of his philosophy[18]. Nevertheless, I tried to point out that it is important, valuable, refreshing and even amusing sometimes to exercise our minds and use "Nietzschean glasses" to consciously, humbly and critically look through them on the world, science, scientists, ourselves… myself.

15. As Howard Caygill explains ***"This is a world construed from the standpoint of a particular "centre of force" - the human subject - and is but an expression of the will to power of this centre of force."*** (Caygill, 1999, p. 28).

16. ***"(...) For an ascetic life is a self-contradiction"*** (Nietzsche, 2008, III:11)

17. Perhaps this anthropocentric madhouse – when particular values, truths and morals are turned upside down and eviscerated – could be shortly illustrated with a recent, highly controversial and unfortunately politicized case of Italian woman Eluana Englaro:

http://www.independent.co.uk/news/world/europe/church-fury-as-coma-woman-allowed-to-die-1017959.html

http://www.independent.co.uk/news/world/europe/italian-coma-womanrsquos-death-ends-berlusconirsquos-bid-to-keep-her-alive-1605508.html

http://www.corriere.it/english/09_febbraio_10/eluana_9057b400-f78c-11dd-8e36-00144f02aabc.shtml

http://www.irishtimes.com/newspaper/world/2009/0211/1233867931612.html

Eluana suffered serious brain damage in a car crash in 1992 and, in result, spent 17 years in a so called ***persistent vegetative state*** (PVS). And whereas science has had a hard time defining and classifying PVS, especially in the context of recognizing it as death (Jennett, 2002), representatives of the Church and religious people insisted on prolonging Eluana's state (of vegetative life), what was possible only thanks to the artificial support (that is scientific technology in medicine, that also invented the term of PVS which it cannot define) - because Eluana could have definitely not survived for 17 years supported even by the most zealous prayers. But, when those who "allowed her to die" by removing the feeding tube and terminating artificially supported life, the opponents of this action called it "a murder". ***"What we should fear, what has a disastrous effect unlike any other, would not be a great fear of humanity but a great loathing for humanity; similarly, a great pity for humanity. If both of these were one day to mate, then something most weird would at once inevitably appear in the world, the "ultimate will" of man, his will to nothingness, to nihilism"*** (Nietzsche, 2009, III:14)

18. ***The Will to Power*** and ***Nihilism*** in particular;

REFERENCES:

Anonymous, (1890), "The Aim and Future of Natural Science", Science 16(404):239-244.

Babich, B., E., (1994). Nietzsche's Philosophy of Science. State University of New York Press.

Babich, B., E., Cohen, R., S., (Eds.) (1999). Nietzsche, Theories of Knowledge and Critical Theory: Nietzsche and the Sciences I. Springer.

Call, L., (1998). "Anti-Darwin, Anti-Spencer: Friedrich Nietzsche's Critique of Darwin and 'Darwinism'", History of Science 36(111):1-22.

Caygill, H., (1999), "Nietzsche and Atomism", in: Babich, B., E., Cohen, R., S., (Eds.), Nietzsche, Theories of Knowledge and Critical Theory: Nietzsche and the Sciences I. Springer.

Connolly, W., E., (2002). Identity\Difference: Democratic Negotiations of Political Paradox. University of Minnesota Press.

Dawkins, R., (2007). The God Delusion. Black Swan.

Del Caro, A., (2004). Grounding the Nietzsche Rhetoric of Earth. Walter de Gruyter.

Gribbin, J., (2003). Science. A History 1543-2001. Penguin Books.

Hansson, S., O. (2007). The Art of Doing Science. Department of Philosophy and the History of Technology, KTH.

Harries, K., (2002). Infinity and Perspective. The MIT Press.

Kaufmann, W., (1974). Nietzsche, Philosopher, Psychologist, Antichrist. Princeton University Press.

Nietzsche, F., (1968). The Will to Power. Kaufmann, W., (transl.). New York: Random House.

Nietzsche, F., (1974). The Gay Science: With a Prelude in German Rhymes and an Appendix of Songs. Kaufmann, W., (transl.). New York: Vintage.

Nietzsche, F., (1982). Daybreak: Thoughts on the Prejudices of Morality. Tanner, M., (transl.), Cambridge University Press, Cambridge.

Nietzsche, F., (1996). Human, All Too Human: A Book for Free Spirits. Faber, M., Lehmann, S., (transl.). University of Nebraska Press.

Nietzsche, F., (2009), On the Genealogy of Morals. A Polemic Act. Johnston, I. (transl.), Vancouver Island University, Nanaimo, BC. http://records.viu.ca/~johnstoi/Nietzsche/genealogy3.htm

Seigfried, H., (1990). "Autonomy and Quantum Physics: Nietzsche, Heidegger, and Heisenberg", Philosophy of Science 57(4):619-630.

Shapin, S., (1998). The Scientific Revolution. The University of Chicago Press.

Spencer, H., (1868). The Principles of Biology. Williams and Norgate.

Wilde, O., (1889), "The Decay of Lying: An Observation", in: Wilde, O., (1891). Intentions.

http://www.mnstate.edu/gracyk/courses/phil%20of%20art/wildetext.htm

"I'm as liberal as liberal can be. That's why I'd like to see every Taliban who isn't capable of acting like a decent human being, erased from the face of the earth.

You can't negotiate with those who have chosen to be inhuman."

http://www.huffingtonpost.com/2009/02/17/obamas-war-on-terror-may_n_167761.html?page=10&show_comment_id=20996918#comment_20996918

INPUT TO THE WORKSHOP LINKING SCIENCE TO SOCIETAL BENEFITS: WHY, WHEN AND HOW?

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Climate research has strong roots in a problem-solving rational. It has aimed to identify and propose remedies for a potential threat to nature and societies. The widen agenda has expanded the empirical focus of climate research. This has induced some researchers to call for not only additional research fields to contribute, but for new approaches and scientific practices. The IPCC process raises the question of when to link science to social benefits. Several authors involved in the last assessment report of the Intergovernmental Panel on Climate Change (IPCC) call for complementary scientific input to future assessments in the form of transdisciplinary research and sustainability science. IPCC chairman Rajendra Pachauri, argues that it is crucial to link climate science and sustainability science. Former IPCC vice chairman Mohan Munasinghe calls for transdisciplinary research to achieve some of the synthesis of large-scale, long-term, complex and interlinked issues which IPCC shall provide.

In the discussions on whether sustainability science can be characterized as a distinct research field it is often characterised in as transdisciplinary and problem-driven. It is thought develop and apply knowledge to assist policy makers and practitioners to achieve sustainable development. To ensure usefulness, such knowledge should be co-produced interaction between researchers and practitioners, e.g. through participatory research (Clark and Dickson, 2003, Kasemir and Jäger, 2003).

The Synthesis Reports of the IPCC's shall synthesize materials contained within the Assessment Reports, as well as potentially integrating material from the Special Reports. Not only the summary, but also the longer report is intended to be suitable for policymakers.

Synthesising should include forging parts in to a new entirety. The synthesis report of the latest assessment report was more of a compilation than a synthesis. The Synthesis Report of the third assessment, were centred on nine questions submitted by governments. Some observers involved in the IPCC process interpreted this as a more transdisciplinary approach than the last report, since it took its starting point in the needs of the users. Others have criticized this take on transdisciplinary research as being too closely associated to serving the current social structures, making it uncritical and circumscribed. To what extent there is room within sustainability or transdisciplinary science for theoretical challenges, basic research and raising critical issues can be one issue to discuss during the workshop.

On the issue of how science should be linked to social benefits, I would like to discuss the development of climate visualisation and decision theatre.

The concept ***climate visualisation*** refers to interactive research platforms, which uses computer graphics to create visual images of causes and effects of climate change as well as mitigation and adaptation options. Major challenges are the scientific visualisation of complex interlinkages between numerous phenomena in nature as well as society, interrelations across vertical scales over time, substantial uncertainty of feed back mechanisms and often massive numerical representation of scientific results.

Visualisation has for many years been used as a tool in climate system and impact research for communicating results between scientists themselves as well as to a broader public through e.g.

web-based interface and portals and Geographical Information Systems (GIS). . In a survey of on-going climate visualisation initiatives, Nocke et al. (2008) conclude that "recent developments in interactive visualisation using alternative visual metaphors are not wide-spread in the climate community. Thus, a major task for future developments is to further bridge the gap between climate and visualisation expertise ". Developments over the last ten years have put new demands on climate visualisation for three reasons: 1) The need to analyse climate change linkages with other areas in science is increasingly recognized in the scientific community (IPCC 2007) 2) In international negotiations and cooperation, climate change has increasingly been linked to other areas of sustainable development. Visualisation may facilitate to demonstrate these linkages. 3) The interactive potential of visualisation methods and techniques has increased substantially. Adapting them to the needs of climate change research may assist in analysing interlinkages, complexity and scientific uncertainties as well as a platform for participatory research.

A key challenge facing environmental scientists and management is to widen public consultation and strengthen participation during the selection of environmental management options, and to improve the information dissemination process once decisions have been made. A few studies have analyzed how scientific visualisations can increase public knowledge on the climate system and climate change (e.g. Sheppard 2005) or be used to broaden participation by different groups in integrated resource management (e.g. Brown et al 2006). Studies of participatory processes have discussed the impact of visualisation tools for stakeholder involvement in form of digital workshops (Salter et al 2009) or natural resource management consultations (Lewis and Sheppard 2006) and enhanced social reflexivity (Bok and Ruve, 2007).

Interactive visualisation, e.g. in the form of decision theatre (www.decisiontheater.org) can assist in the process of linking science to social benefits. Although, it requires a reflexive approach towards using visualisation as a scientific tool since 1) it implies excluding and including particular part of information 2) the interactivity is not inherent by default but needs analyses of what is communicated and how it is perceived.

CO-PRODUCING EUROPEAN CLIMATE SCIENCE AND POLICY. A CAUTIONARY NOTE ON THE FUNDING AND MAKING OF USEFUL KNOWLEDGE

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INTRODUCTION

The European Union (EU) is often considered to be at the forefront of international efforts to combat climate change. Since spring 2007 when the member states agreed to reduce their greenhouse gas emissions by at least 20 percent from 1990 levels by the year 2020, the EU has both adopted an integrated energy and climate change policy and engaged in a diplomatic mission to secure a UN climate deal beyond year 2012. Science has played a central role in this European climate change strategy. The energy and climate change policy package, proposed by the European Commission (EC) in January 2008, ultimately rests upon the EU commitment to limit the global average temperature increase to no more than 2 degrees Celsius above pre-industrial levels (EC 2007a). In order to establish this temperature target as a credible and feasible goal for international climate policy, the EU has in recent years drawn upon a wide array of climate impact and policy studies (see Tol 2007). The union has also intensified its own investments in climate science and policy research in order to secure adequate science advice (EC 2007b).

In this paper I draw attention to this tight coupling between European climate science and policy. Turning to the analytical idiom of co-production (Jasanoff 2004), the paper examines how knowledge-making practices are incorporated into European climate policy-making, and more importantly, how EU climate policy has influenced the funding, making and interpretation of useful European climate science and policy research. The analysis is based on a case study of the integrated research project ADAM (Adaptation and Mitigation Strategies Supporting European Climate Policy). The ADAM project was funded under the Sixth Framework Programme of the European Union (FP6) from March 2006 to June 2009 and was designed with the ultimate aim to be useful to European policy development in the post-Kyoto era. In a time when the EU has taken a leading role in the UN negotiations on a future climate treaty beyond 2012, the political expectations tied to this 'flagship' of the FP 6 have consequently been high. In this paper I use the ADAM case as a vantage point for analysing what forms of co-production that are shaped by contemporary demands for usable climate science. In my analysis I distinguish between the descriptive dimension of the co-production idiom that helps us to examine how knowledge about the world enables certain ways of being in it (Jasanoff 2004), and the prescriptive interpretations of the term that have gained ground in the science studies literature in recent years. In the latter version, co-production emerges as a normative framework for improved science-society relations and more accountable forms of scientific expertise (cf. Morehouse & Lemos 2005; Corburn 2007; Jasanoff 2003; Nowotny et al. 2002).

Although societal usefulness is only one of many ways of accounting for research success in the normative co-production idiom, it has in recent years turned into a compelling narrative for European science policy-makers. As noted by Jacob (2006a, p. 434), it is now one of the axioms of research policy that the involvement of potential recipients of knowledge in its production will increase the likelihood of utilisation. Perhaps due to the recent scholarly celebration of public involvement in science, the politics of this utilitarian discourse have to date received scant attention. In an effort to move away from the traditional linear model of science that has tied societal benefits to the pursuit of autonomous basic research performed without thought of practical ends (Polanyi 1969), scholars and practitioners alike have primarily focused on the benefits of knowledge produced "in the context of application" (Gibbons et al. 1994). This paper, by contrast, seeks to open up the debate. By studying two 'moments of accounting' when the project's usefulness was negotiated in interplay with the European Commission, it highlights potential risks tied to the funding and making of useful science. The analysis is organised as follows.

First, the ADAM quest for social utility is put in a theoretical context. I here make a distinction between the descriptive and prescriptive dimensions of the co-production idiom and interpret scientific usability as one of the normative principles of accountability that currently shapes the ways in which science-society relations are organised. Second, I introduce the ADAM project and its efforts to produce useful science advice to the European climate policy community. Drawing upon 18 semi-structured interviews with ADAM researchers and participant observations at 8 ADAM meetings from January 2007 to March 2009, the paper examines how scientific utility was negotiated and institutionalised throughout the course of the ADAM project. I end by discussing what the ADAM story tells us about efforts to hold science accountable to the knowledge needs in society. In particular I ask to what extent usefulness as a normative principle of accountability holds the potential to open up taken for granted assumptions and challenge the stability of social and natural orders, so central to the interpretative tradition in science studies. Although it indeed is tempting to reduce, as proposed by Jasanoff (1996), the distance between scholarship and prediction, I conclude that that scholars of science and society need to take careful note of how the prescriptive co-production idiom is interpreted and used in science policy circles. In order to secure a continued space for critical academic engagement with the ontological claims that underpin contemporary policy-making, the ADAM story tells us that the politics of useful science requires further attention. To examine the forms of co-production resulting from the negotiation of scientific usability should not only be of interest in a time when the future direction and scope of international climate policy is being shaped, but in any political context where we hope that academic enquiry will inspire political leaders to think differently.

THE DESCRIPTIVE VS PRESCRIPTIVE IDIOM OF CO-PRODUCTION

In recent years science studies have been widely engaged with the constitutive links between knowledge making practices and social order. Under the analytical label of co-production, scholars in this field have examined how certain ways of representing and knowing the world relate to possible ways of living in it (Jasanoff 2004, p. 2; Latour 2004). Hence, critical analyses of formal systems of knowledge have been coupled with empirical studies of the institutions, cultural beliefs and material resources that sustain and are sustained by particular ways of knowing (Jasanoff 1996, p. 410). In the field of environmental politics, for instance, scholars have examined linkages between the micro-social contexts in which knowledge about the environment is produced and the macro-political institutions that shape social and environmental change on global scales (Miller & Edwards 2001, p. 12; Jasanoff & Martello 2004; Lövbrand & Stripple 2006; Miller 2007). Of central interest to all these studies is how scientific representations of nature are produced, validated and used to give meaning to socio-political arrangements. In line with Foucauldian governmentality studies (cf. Barry et al. 1996; Dean 2004; Miller & Rose 2008), this analytical tradition assumes that the ways in which we think about and represent reality are intimately linked to the ways in which it is acted upon and governed. Hence, in order to understand what is thought, said and done, it is necessary to identify and describe the knowledge practices that make these things thinkable, sayable and doable (Miller & Rose 2008, p. 3; Lövbrand et al. 2009).

This descriptive/interpretative version of the co-production framework has in recent years been complemented by a more prescriptive idiom. In the mid 1990s Jasanoff (1996) advocated a normative turn to science studies. An interpretative enquiry that highlights the contingent and contextual nature of authoritative knowledge does not automatically have to be morally neutral. Rather, Jasanoff defended sociological accounts of contending knowledge claims that are coupled with a normative commitment to social change. One of the normative commitments that since then have gained firm ground among scholars of science and society is the proposition that members of the public should be involved in matters of science and technology. Nowotny et al. (2002, p. 119) have talked about a shift from a "culture of scientific autonomy to a culture of accountability" that is intended to open up the knowledge production system to affected constituents. From this vantage point the co-production idiom seems to be less about describing and interpreting the constitutive relationship between authoritative knowledge and social order. Instead it emerges as a prescriptive framework for engaging non-scientists as active partners in the funding, making and use of such knowledge. A quick review of the literature in this field suggests that there are at least two arguments underpinning this scholarly commitment to public consultation, participation and debate.

The first argument rests upon an underlying critique of the instrumental forms of co-production that have prevailed in the past. As argued by Callon (1999, p. 89), the involvement of lay people in the creation of knowledge stems from a tension between the production of standardised and universal knowledge on the one hand, and the production of knowledge that takes into account the complexity of local situations on the other. The former kind of knowledge is typically associated with traditional scientific expertise that, according to critics, too often is (mis)used to 'close down' questions of meaning and value (Wynne 2003; Stirling 2008). By referring to dominant forms of expertise, the exercise of judgement is hidden in political contexts and normative presumptions are hereby locked away from public review and criticism (Jasanoff 2003). If universal knowledge claims have been criticised for pre-empting political discussion, the latter kind of knowledge holds the promise of more open-ended and inclusive deliberations over questions of common purpose. Resting upon a respectful collaboration between professionals and concerned groups in society, such "research in the wild" (Callon & Rabeharisoa 2003) is expected to bring new perspectives to the fore that may "open up questions, provoke debate, expose differences and interrogate assumptions" (Wilsdon & Willis 2004, p. 40). From this vantage point, co-production emerges as a reflexive and emancipatory project that strives to "develop a collective capacity to reflect upon salient narratives and their roles in shaping society" (Felt & Wynne 2007, p. 75).

Hence, while the first argument for public involvement in science is informed by what Barry et al. (2008) have called "a logic of ontology" (i.e. an orientation towards effecting ontological change), the second argument takes the co-production idiom in a more utilitarian direction. Also this argument rests upon a concern that science in the aggregate has failed to live up to its promise to work for the benefit of society as a whole (Brunner & Ascher 1992; Lemos & Dilling 2007; Woodhouse & Sarewitz 2007). However, rather than seeking to open up and transform existing ways of thinking, this second line of arguing is more concerned with adjusting research portfolios to the plurality of knowledge needs in society. Following "a logic of accountability" (Barry et al. 2008), efforts to involve members of the public in the funding and making of science here assume that societal knowledge users should have a say in the governance of science. Such involvement will both compel scientists to justify the social benefits of their research and empower diverse publics to shape research portfolios in accordance with their needs (Sarewitz & Pielke 2007). To ask scientists to 'co-produce useable knowledge' through every-day collaboration with policy-makers and the public hereby emerges as an effort to make research results more applicable to problem-solving (Lemos & Morehouse 2005; Nowotny et al. 2002). From this vantage point "the consequences of new knowledge cannot be regarded as being 'outside' the research process because problem-solving environments influence topic-choice and research design as well as end-uses" (Nowotny et al. 2003, p. 187).

Although these two logics of science often are entangled in the normative co-production idiom, they do not necessarily go hand in hand in practice. Whereas the logic of ontology is faithful to the descriptive co-production framework and its ambition to problematise dominant forms of knowledge, a utilitarian interpretation of the logic of accountability may take the academic enquiry in a different direction. By linking the accountability of science to its ability to meet societal knowledge needs, some proponents have hoped to develop a synergistic relationship between knowledge producers and users that will reshape the perceptions, issue framings and agendas of respective group (Lemos & Morehouse 2005, p. 61). However, if we make the eligibility of funding dependent on user groups' testimony that the proposed research is useful to them (Jacob 2006, p. 25), we may also run the risk of reifying the instrumental forms of co-production that scholars of science and society are so eager to challenge. As noted by Jacob (2006, p. 30); "user control could result in an overly conservative and too narrow research agenda since users would not be able to take risks on ideas coming from outside of the body of knowledge to which they are used." In the following sections of this paper I address this risk by turning to the ADAM project and the ways in which its mandate to produce useful science was negotiated and interpreted in interplay between the involved researchers and the European Commission (EC).

SCIENCE IN SUPPORT OF EUROPEAN CLIMATE POLICY

In June 2004 the European Union opened its third call for proposals under the Sixth Framework Programme (FP6) for European research and technology development. With the third largest operational budget in the EU after the Common Agricultural Policy and Structural Fund, FP6 was designed to achieve the March 2000 Lisbon European Council goal of turning Europe into the world's most competitive knowledge-based economy by 2010 (EC 2004). As such it has aimed to create "a true European internal market for research and knowledge" where European research and development efforts are better integrated (EC 2004, p. 9). Of the total budget of 15.5 billion EUR during the period 2002-2006, FP6 set aside 12 billion EUR for seven key areas or "thematic priorities". One such priority is "Global Change and Ecosystems," with the ADAM project (Adaptation and Mitigation Strategies Supporting European Climate Policy) as one of its largest integrated projects (IP).

The ADAM project came about in a time when climate change was gaining political high ground in Europe. When the project proposal was prepared in early 2005, the Kyoto Protocol had just entered into force and the EU 15 commitment to reduce greenhouse gases by 8 percent from 1990 levels by 2012 was transformed from a moral to a legal obligation. At this point in time the political leaders in Europe had also just launched the EU Emissions Trading Scheme (EU ETS) to increase the flexibility and cost-effectiveness of the climate mitigation efforts within the union. While the expectations tied to this internal market for emission allowances were high, so were the challenges lying ahead. In 2005 the greenhouse gas emission were still rising in most EU member states. In order gain credibility for its efforts to move the UN negotiations into a next phase beyond year 2012, the union therefore had to step up its internal efforts to combat climate change. The ADAM project was designed to give input to this process. As suggested by the project proposal (Hulme 2005, p. 1), "(t) he main impact of the ADAM project will be to improve the quality and relevance of scientific and stakeholder contributions to the development and evaluation of climate change policy options within the European Commission. This will help the Commission to deliver on its medium-term climate policy objectives and help inform its development of a longer-term climate strategy."

The ADAM project received funding in March 2006 and ran until June 2009. The total project budget for this period was 18.2 million EUR, of which the EC contributed 12 million. The project was coordinated by the University of East Anglia and the Tyndall Centre for Climate Change Research in the UK. In total, it involved some 200 researchers from 27 universities and research institutes across Europe. Since the EC Directorate-General for Research (DG Research) manages the EU Framework Programmes, it has also been the main recipient of the ADAM research results. However, the Directorate-General for the Environment (DG Environment) and its climate change unit also showed great interest in ADAM. Responsible for the preparation of climate policy proposals in the EC, members of the DG Environment were at an early stage of the ADAM project invited to comment on the research design (Hulme 2009, personal communication). The core objectives of the project were hereby closely aligned with the policy agenda of the Commission. According to the project proposal (Hulme 2005, p. 4), these core objectives are:

(1) to assess the extent to which existing and evolving EU mitigation and adaptation policies can achieve a tolerable transition (a 'soft landing') to a world with a global climate no warmer than 2 degrees Celsius above pre-industrial levels, and to identify their associated costs and effectiveness, including an assessment of the damages avoided compared to a scenario where climate change continues unchecked until 5 degrees Celsius;

(2) to develop and appraise a portfolio of longer term strategic policy options that could contribute to addressing identified shortfalls both between existing mitigation policies and the achievement of the EU 2 degree target, and between existing adaptation policy development and implied EU goals and targets for implementation

(3) to develop a novel Policy-options Appraisal Framework (PAF) and apply it both to existing and evolving policies, and to new, long-term strategic policy options.

In order to fulfil these objectives, the ADAM project was organised around four overarching research domains; ***scenarios, mitigation, adaptation*** and the ***policy appraisal framework***. Each domain was in turn divided into a number of work packages. The ***scenario domain*** was involved in the making of four climate scenarios that would guide the ADAM analysis. The scenarios spanned a range of climate futures from a 2 degree C global warming where the primary challenge is mitigation, to a 5 degree C warming outcome where the primary challenge is adaptation. The ***mitigation domain*** focused on the costs and effectiveness of different mitigation options at the EU level. The ***adaptation domain,*** in turn, analysed Europe's vulnerability to climate change. Social, technical and environmental factors that influence adaptive capacity were in focus. Finally, the ***policy appraisal domain*** engaged in the development of the 'Policy Appraisal Framework' – an integrated and participatory method for assessing and reflecting upon long-term strategic policy options for Europe. Each research domain was coordinated by leading European scientists in academic fields such as climate and economic modelling, integrated assessment analysis, policy analysis, development studies and global governance studies. While specialists in their respective fields, the involved scientists set out to jointly appraise European climate policy options and thus offer integrated decision support in a time when the climate policy landscape was under re-negotiation.

In the following section I examine how the ADAM participants designed their research activities to live up to the ambition to provide useful guidance to the EU climate policy community. While the project proposal identified interaction with key policy actors as a central way of securing the relevance and use of the ADAM findings (Hulme 2005, p. 11), the project participants explored a variety of arenas and modes for such interaction.

DESIGNING USEFUL AND REFLEXIVE POLICY APPRAISALS

The ADAM project taps into the normative co-production idiom and its utilitarian logic of accountability. Policy relevance and usefulness emerge as central concepts in the project proposal and most interviewed work package leaders agreed that it is of great importance that the ADAM research results feed into the EU climate policy development and inform the ongoing UN post-2012 talks (personal communication with Edenhofer 2007, Haxeltine 2008, Eskeland 2007, Werners 2007). Along these lines, the ADAM project was designed to facilitate a co-production process between the involved researchers and the EU climate policy community. By working across disciplines and with key policy actors within the EC and the member states, the research team set out to initiate a process of social learning that would deliver "a truly unique series of processes and products in support of EU climate policy" (Hulme 2005, p. 6). The project's novel Policy Appraisal Framework (PAF) was the key mechanism that would set this innovative co-production of knowledge and policy into motion.

Drawing upon the project team's experiences from the field of Integrated Assessments (IA), the PAF set out to combine quantitative modelling of the climate system with participatory and deliberative approaches in the appraisal of strategic policy options. While the integrated approach was expected to bring together analysis and insights from the project's many different disciplines (e.g. climate science, economics, development theory, policy studies), the participatory elements held the promise of providing insights into the political feasibility and public acceptability of different policy options. In order to be useful to a fast moving policy debate, the PAF's integrated perspectives and sustained interactions with stakeholders in the policy community were thus framed as crucial (Hulme 2005, p. 16). Although policy relevance and decision support were the guiding principles for the PAF, the framework also included elements that resonate with the reflexive co-production idiom and Barry's et al. (2008) logic of ontology. According to an early PAF guidance document, the added value of multiple perspectives in the appraisal process lies in its promise to contribute to social learning. When actors from different disciplines and societal sectors come together in a cooperative way to discuss the challenges of climate change, the PAF research team expected that they would learn from each other and jointly arrive at new framings and understandings of the issues at stake (Haxeltine et al. 2007, p. 5). Following Barry et al. (2008, p. 25), such reflexive appraisals would, in the best of worlds, produce a space of multiplicity and difference that challenges and transforms existing ways of thinking about the content, scope and direction of EU climate policy.

However, one year into the project it became clear that the PAF would not realise its innovative potential and help the ADAM project to deliver both useful and reflexive policy appraisals. In February 2007 two independent reviewers were asked by DG Research to evaluate the progress of ADAM. One central line of review critique concerned the PAF and its failure to deliver a functioning method for project integration and decision-support as promised in the project proposal (Verbruggen & Böhringer 2007). Developed as a generic tool for climate policy appraisals in a rather top-down fashion, the PAF had run into internal critique and resistance within the ADAM research group (Hauge et al. XX). As a consequence, the innovative co-production process envisioned by the PAF was not initiated. The reviewers noted that the PAF to date was neither particularly innovative nor useful for structuring the work in the other ADAM work packages. Although some work packages had embarked on stakeholder exercises, this interaction was carried out with little or vague guidance from the PAF. In other work packages the stakeholder engagement was low resulting in limited prospects for useful research results. Hence, although the PAF was informed by the normative co-production idiom, the reviewers ironically identified the lack of stakeholder involvement in the design of the PAF as a major shortcoming that undermined the ADAM project's ability "to hook up with the reality of climate policy making" (Verbruggen and Böhringer 2007, p XX)

In face of this severe critique, the ADAM steering group decided to downplay the role of the PAF and instead organise the continued research efforts around other means and modes of stakeholder engagement (see ADAM 2007). As specified in the project proposal (Hulme 2004, p. 12), the interface with the climate policy community would also be informed by a cycle of six ADAM climate science and policy workshops hosted by the Centre for European Policy Studies (CEPS) in Brussels. Considering CEPS' tight links to key actors in the EU system, these seminars held the promise of a regular and close dialogue with the European climate policy community. In parallel to the CEPS seminars, the ADAM steering group also highlighted planned side-events at upcoming UN climate talks as an important meeting place for ADAM researchers and non-academic experts and opinion leaders (ADAM 2007). Moreover, the various work packages were encouraged to pursue individual stakeholder workshops to gain input on their research findings. Beyond these organised stakeholder events, the steering group also emphasised the importance of continued informal dialogues between the ADAM research team and relevant stakeholders in the DG Environment and the DG Research (see ADAM 2007).

In the following section I discuss how these efforts to place the ADAM research 'in the context of application' played out in practice. The aim is not to provide a complete picture of the ADAM project's rich and diverse series of stakeholder interactions. Rather, drawing upon two selected examples I seek to illustrate how the negotiation of usability can be enacted in interaction with the policy community. Rather than contributing to reflexivity and the reframing of policy goals, these two examples point to a more instrumental logic oriented towards a short-term and narrow interpretation of policy relevant climate research.

INTERPRETING USEFUL CLIMATE POLICY RESEARCH

In late January 2008 the ADAM work package on policy and governance organised their first stakeholder workshop in Brussels. The aim of this one-day event was to present European policy makers and experts closely linked to the policy process (e.g. NGOs, business actors) with the findings of research team. At this point in time this particular work package had concluded a review of 262 publicly available ex-post evaluations of climate policies implemented at the EU level and by six EU member states (Germany, the UK, Finland, Italy, Portugal and Poland). Through the review, the research team aimed to assess policy success and failure and to map the landscape of evaluation practice in a range of member states (ADAM 2008). The workshop was organised as a meeting place where the ADAM researchers hoped get input and ideas on their work from their main stakeholder groups, and hereby prepare ground for their continued research (Hauge 2008, personal communication). However, among the 40 participants registered for this event, only a minority represented the stakeholder groups targeted by the ADAM research team (i.e. policy practitioners). More than half of the participants were instead members of academia. Only two representatives from the European Commission attended along with another six civil servants from ministries and public agencies in member states.

The workshop organisers offered several explanations for this limited interest from the European climate policy community. First of all, they suggested that the workshop had been caught up in a controversy between DG Research and DG Environment over the management of the ADAM project's research agenda (Haug 2008, personal communication). Although DG Research functions as the main coordinator of the EU framework programmes and as such performed the formal evaluation of the ADAM project, the climate change unit in the DG Environment had taken great interest in the ADAM research agenda. Two days prior to the ADAM workshop, the DG Environment had presented their "Climate action and renewable energy package" in which they outlined means by which the EU best would meet its 20% reduction target for greenhouse gas emission by 2020 (see EC 2008a). The proposed package rested upon a far-reaching impact assessment performed by the DG Environment's climate change unit (EC 2008b). Since the cost of various policy options was one of the main indicators in this assessment, a number of economic modelling tools were used to produce quantitative cost estimates.

According to the ADAM workshop organisers, there was a sense of dissatisfaction within the DG Environment that the ADAM policy evaluations had not fed useful information into this assessment process. Focused on the qualitative, rather than quantitative, aspects of policy success and failure, the ADAM research was not directly applicable to the Commission's work and therefore of little interest to the policy community in Brussels (Hauge 2008, Berkhout 2008, personal communication). However, since the DG Environment had no direct influence over the ADAM research agenda, they could not compel the research team to change focus. Instead they asked another European research group to conduct the quantitative policy evaluations they needed. The extent to which this controversy affected the turnout of this particular ADAM stakeholder workshop is difficult to say. However, it did cause a certain degree of disappointment within the research team and raised questions about the conditions under which science should engage with policy. Later the same year the scientific coordinator of the policy and governance work package reflected upon the mismatch between their research agenda and the knowledge needs of the policy community in Brussels. He noted that the lack of interest in their work partly was a result of the current phase of the EU climate policy cycle;

"When faced with the pressure to gain member state support for the EU climate policy package and a post-2012 strategy for the UN climate negotiations in Copenhagen in December 2009, EC policy makers are focused on technical details rather than the broader appraisal questions raised by ADAM. In this phase of the policy cycle, policy researchers like us cannot contribute with much useful advice. It is rather vice versa. Policy makers can teach us a lot. However, in another phase of the policy cycle when issues open up, we can contribute to the long-term discussion on future climate policy" (Berkhout 2008, personal communication).

Moreover, the work package leader pointed at the limited number of decision makers responsible for climate policy in the Commission. In order to engage with this central stakeholder group, researchers need to make good contacts with key actors that have time and interest to engage in a mutual dialogue. Had the ADAM research team had more success in their initial contacts with this stakeholder group, they may have been prepared to change their research agenda and engage in more participatory research. However, when the researchers failed to create meaningful interaction, they disengaged and adopted a more traditional research design and dissemination strategy (Berkhout 2008, personal communication).

This lack of interest in the ADAM findings may come as no surprise to scholars interested in the usability of science. Science policy analysts have time and again reminded us that research performed without thought of practical ends tends to be underutilised or not used at all in decision making (see for instance, Sarewitz & Pielke 2007). Hence, when following a utilitarian interpretation of Barry's et al. (2008) logic of accountability, the ADAM story above could easily be interpreted as a failure on the part of the research team to successfully adjust their agenda to the context of application. Had members of the European policy community been invited to have a say in the formulation of research questions and the choice of research methods, they may have taken greater interest in the results. However, the lack of meaningful interaction can also serve as an example of the tensions between 'useful' policy appraisals that seek to serve the knowledge needs of stakeholders on the one hand, and 'reflexive' policy appraisals, on the other hand, that aim to create a space of difference where taken-for-granted policy goals can be discussed and challenged. To open up the policy debate to new ideas may not be seen as particularly useful by policy practitioners who are in the process of closing it. Nonetheless, this is exactly what the reflexive co-production idiom and Barry's et al. (2008) logic of ontology is all about.

Although stakeholder engagement in this particular ADAM case did not invite policy reflection, the resulting disengagement from the policy community did give the research team a greater space for intellectual innovation and critique than if they had adjusted to the knowledge needs of the DG Environment. This trade-off between reflection and usability suggests that the normative co-production idiom harbours inherent tensions that require further examination. The ADAM story offers a second example of how this trade-off plays out in practice. Also in this second case the usability of the ADAM findings was put into question by the policy community. However, rather than resulting in disengagement, this second moment at which the accountability of ADAM was negotiated paved the way for closer links between the ADAM knowledge practices and the Commission's interpretation of desirable climate policy goals.

RE-NEGOTIATING THE SPACE FOR REFLECTION AND CRITIQUE

Since the mid 1990s when the Kyoto Protocol was negotiated, the EU has advocated and defended a 2 degree temperature target in the UN climate negotiations. In order to avoid a dangerous human interference with the climate system, the EU has suggested that global mean temperature should not be allowed to rise above 2 degrees Celsius from pre-industrial levels (for an overview, see e.g. Tol 2007). The implications of the EU target for future greenhouse gases has been widely debated in both policy and science circles during the past decade. Due to the complexity of the climate system, any attempt to link greenhouse gas emissions to a clear temperature response has been fraught by great uncertainty and controversy. Nevertheless, on the basis of extensive scientific advice, the EU has argued that atmospheric concentrations of greenhouse gases must stabilise below 450 ppm or lower under the assumption that such a level offers at least a 50% chance of achieving the 2 degree target (EU Climate Change Reference Group 2008, p. 47).

As indicated above, a core objective of the ADAM project was to assess the mitigation and adaptation policies necessary to reach this ambitious EU target, and to identify their associated costs and effectiveness. Situated at "the interface between research, negotiation and implementation" (Hulme 2004, p. 4), the project team wanted to offer the tools necessary to identify, illuminate and appraise the available policy options. However, to assess and develop portfolios of climate policy options for Europe is not necessarily the same as to give support to existing policy goals or proposals. Considering the reflective ambition embedded in the PAF, the ADAM appraisal process also held the promise of policy alternatives that would challenge existing policy goals and agendas (ADAM 2009). Nonetheless, in late 2007 the ADAM research team received signals from DG Environment that they were unhappy with the political implications of the ADAM findings. During the UN climate talks in Bali in December 2007, the EU negotiators had been put under political pressure by the USA to demonstrate the credibility and technical feasibility of their 2 degree target. At the same time other negotiating parties, such as the Alliance of Small Island States (AOSIS), were calling for even more stringent targets. Since the ADAM policy appraisals could be interpreted to suggest that the current portfolio of EU climate policies was inadequate to reach the 2 degree target, the project was pulled right into the politics of the post-2012 negotiations (Hulme 2009, personal communication).

As a consequence, a selected group of ADAM researchers were called to a special meeting with members from DG Research and DG Environment in Brussels in January 2008. During this meeting the DG Research proposed that the research agenda of the ADAM work packages on mitigation and scenarios should be modified to accommodate the low emission stabilisation scenarios called for by the DG Environment. The meeting resulted in a number of new project deliverables for ADAM such as two reports addressing the technical feasibility of low forcing scenarios and emission pathways, and a one-day CEPS/ADAM policy seminar in Brussels exploring the technical feasibility and political and economic significance of securing a 400 ppm rather than a 450 ppm greenhouse gas stabilisation pathway (DG Research 2008). Although an appraisal of the policy options necessary to reach the 2 degree target already was part of the ADAM project plan, this incident put increased emphasis on the significance and feasibility of such policy trajectories. And indeed, in the policy brief from the CEPS/ADAM workshop held in February 2009, the ADAM research team concludes that the EU needs scientific support to show that the 2 degree target is "technically feasible, economically viable and politically manageable" (Neufeldt et al. 2009, p. 3). Considering the high political stakes built into this political target, the policy brief represented a very careful balancing act between an independent critical appraisal of available (and future) climate policy options and a demonstration of the mitigation potential built into the same.

Even though this negotiation of usability between the Commission and ADAM only affected some project participants, it does point at the reduced space for reflection and critique offered by a narrow utilitarian interpretation of scientific accountability. When asking EC policy-makers to interpret what counts as useful knowledge, we are more likely to see research that gives pragmatic input to the immediate policy goals at hand than policy appraisals that seek to challenge them. Although the ADAM project team set out to critically assess the 2 degrees temperature target without being locked up in politics, there was too much political capital invested in that target for ADAM to provide independent critique (Hulme 2009, personal communication). Hence, rather than opening up the debate on what constitutes technically feasible, economically viable and politically manageable climate goals through a reflexive co-production process with the European climate policy community, the project's utilitarian framing resulted in a more instrumental mode of engagement steered by the political agenda of the Commission.

DISCUSSION AND CONCLUSIONS

This paper has drawn upon two 'moments of accounting' in the European ADAM project to discuss the forms of co-production resulting from the funding and making of useful science. Naturally the examples examined here only offer a partial picture of the rich and diverse ADAM policy appraisal process. To give a comprehensive account of how the ADAM project came about and developed is beyond the scope of this paper. While situated and incomplete, I nevertheless argue that the examples drawn upon here speak to the broader scholarly debate on how to link science to society. Hence, I hereby end with two observations and one recommendation aimed for scholars in this field. Firstly, following the descriptive co-production idiom, the ADAM story tells us that there are close links between European climate science and policy. Although this paper points to an uneasy relationship between ADAM researchers and the climate policy community in Brussels, the project's mandate to produce policy relevant knowledge did shape the formulation of research questions and choice of methods in many ADAM work packages. While far from all ADAM researchers were committed to the normative idiom of co-production, they did want their research to be used. As a consequence, the various research teams embarked on more ambitious stakeholder exercises and developed closer links to European climate policy-making than what normally is the case in traditional academic research.

Secondly, the 2 degree controversy suggests that the ADAM knowledge making practices did indeed tap right into the politics of climate change. Although far from all ADAM research results were interpreted as immediately useful in the policy-making process, it is possible to argue that the project's policy appraisal practices contributed to the discursive matrices within which European climate policy (such as the 2 degree goal) is articulated, enacted and defended. As implied by the descriptive co-production framework, government is always dependent upon knowledge. From this vantage point scientific findings do not only legitimate existing power relations. Ways of reasoning about and evaluating climate change, as well as identifying its problems and solutions, have a constitutive function and hereby help to establish the climate as something governable (Miller & Rose 2007, p. 31). Along these lines one could argue that the ADAM findings have simultaneously been informed by and informed particular understandings of the climate problem and how it best is governed. By studying these mutually constitutive links between European climate science and policy, we may thus get a sense of what Jasanoff (2004, p. 6) has called "the constant intertwining of the cognitive, the material, the social and the normative".

The extent to which such an analysis gives room for critique and the projection of alternative forms of co-production is, however, less clear. As argued by Collins and Evans (2003, p. 444), the observation that science and politics are entangled does not automatically tell us how to act in face of this sociological fact. The 'ought' cannot be obtained from the 'is'. Nonetheless, a growing cadre of science and technology scholars has in recent years advanced a normative interpretation of how science and social order best is co-produced. What previously appeared as 'morally neutral' work on the sociology and politics of knowledge currently includes explicit normative commitments and prescriptions for social change. Through the normative co-production idiom, the sceptical and reflexive approach to scientific knowledge, so central to this field of enquiry, is today regularly coupled with authoritative recommendations for more effective science policy decisions and accountable forms of expertise. In this paper I have offered one example of how such recommendation may affect research practice. Balancing between the call for reflexive forms of knowledge on the one hand, and useful policy advice on the other, the ADAM project exemplifies contemporary efforts to translate the normative co-production idiom into practice.

The ADAM story told here does, however, not paint a rosy picture of knowledge produced in the context of application. Instead of turning into an innovative site for policy re-examination and learning, the ADAM project was time and again asked to respond to the policy community's narrow interpretations of useful knowledge. Since project's contract with the European Commission hinged on its policy relevance and usefulness, the space for critical engagement with the ontological claims that underpin contemporary policy-making was hereby restricted. In the worst case, this form of co-production closed down, rather than opened up, the interpretation of feasible and desirable climate policy goals in the post-Kyoto era. However, this is obviously not the full story of the ADAM research process. Beyond the more instrumental interplay with the policy community, the ADAM researchers continued to debate strategic climate policy options for Europe. In face of the limited policy interest in the more reflexive dimensions of the ADAM appraisal process, this debate was primarily conducted in and disseminated through traditional academic arenas and fora (ADAM 2009, p. 37). Hence, while designed to venture 'into the wild', the ADAM project returned to its academic peers.

The ADAM project's struggle to translate the normative co-production idiom into practice does not allow us to draw any general conclusions. However, it can help us to reflect upon the tensions built into the policy prescriptions advanced in contemporary science and society studies. Rather than confirming the many benefits tied to knowledge produced in the context of application, the ADAM story suggests that a utilitarian interpretation of accountable science runs the risk of defusing its critical and reflexive ambition. In order to make the scientific journey from a culture of autonomy to a culture of accountability intellectually compelling and rewarding, I therefore recommend scholars of science and society to carefully reflect upon the practical consequences of their own prescriptions and the various accountability standards built into the normative co-production idiom.

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REFERENCES (INCOMPLETE)

ADAM 2007. Year 1 Review: Response by the Consortium. Private copy available from author.

ADAM 2008. Evaluating European Climate Policy: Lessons for the Future. Workshop briefing note, Brussels, 28 January 2008.

Barry, Andrew, Born, Georgina, and Weszkainys, Gisa 2008. Logics of interdisciplinarity, Economy and Society 37 (1), pp. 20-49.

Brunner, R. D. and Ascher, W., 1992. Science and Social Responsibility, Policy Sciences 25, 295-331.

Collins, H.M. and Evans, R. 2003. King Canute meets the Beach Boys: Response to the third wave, Social Studies of Science 33 (3): 435-452

European Commission (EC) 2008a. Proposal for a Decision by the European Parliament and the Council on the Effort of Member States to Reduce their Greenhouse Gas Emissions to Meet the Community's Greenhouse Gas Reduction Commitments up to 2020. Brussels 23.1.2008. COM (2008) 17 final.

European Commission (EC) 2008b. Commission Staff Working Document. Impact Assessment. Document Accompanying the Package of Implementation Measures for the EU's Objectives on Climate Change and Renewable Energy for 2020. Brussels 23.1.2008. SEC (2008) 85/3.

Felt, U., and B. Wynne. 2007. Taking European knowledge society seriously. Report of the Expert Group on Science and Governance to the Science, Economy and Society Directorate. Directorate General for Research, European Commission.

Funtowicz, S.O. & Ravetz, J.R. 1993. Science for the post-normal age, Futures 25 (10): 739-755.

Haxeltine, A., van de Kerkhof, M., Tabara, Weaver, Pett, Zelli, Bäckstrand, K, Berk, M., Cots, F., Falaleeva, M., Masse E 2006. The ADAM Policy Appraisal Framework. Introduction and Guidance. Tyndall Centre for Climate Change Research, University of East Anglia, Norwich NR4 7TJ, UK

Hulme, M. 2004. Adaptation and Mitigation Strategies: Supporting European Climate Policy. Project proposal to sub-priority 1.1.6.3 'Global change and ecosystems', sub-priority research area I.3 'Mitigation and adaptation strategies', sub-priority research topic I.3.1 'Adaptation and mitigation strategies', 3rd call: 17 June 2004.

Jacob, M. 2006. Re-norming the science-society relation, Tertiary Education and Management 12: 21-36.

Jasanoff, S. 1996. Beyond epistemology: relativism and engagement in the politics of science, Social Studies of Science 26, 393-418.

Jasanoff, S. 2003. Technologies of humility: citizen participation in governing science. Minerva 41: 223-244.

Jasanoff, S. 2004. States of knowledge. The co-production of science and social order. London & New York: Routledge.

Lemos, M.C. & Morehouse, B.J. 2005. The co-production of science and policy in integrated assessments. Global Environmental Change 15: 57-68.

Lemos, M. C. and Dilling, L., 2007. Equity in Forecasting Climate: Can Science Save the Poor? Science and Public Policy 34 (3), in press.

Neufeldt, H., van Vuuren, D., Isaac, M., Knopf, B., Edenhofer, O., Schade, W., Jochem, E. and Berkhout, F. 2009. Reaching the 2 Degree Target: Technological Requirements, Economic Costs and Policies, CEPS Policy Brief 188.

Nowotny, H., Scott, P. & Gibbons, M. (2002). Re-thinking science. Knowledge and the public in an age of uncertainty. Polity Press, Cambridge.

Polanyi, M., 1962. The Republic of Science, Minerva 1, 54-73.

Sarewitz, D. & Pielke Jr, R. 2007. The neglected heart of science policy: reconciling the supply of and demand for knowledge, Environmental Science and Policy 10:5-16.

Tol, R.S.J. 2007. Europe's long-term climate target: a critical evaluation, Energy Policy 35, 424-432.

Verbruggen, A. and Böhringer, C. Consolidated Review Report of FP6 Projects. Adaptation and Mitigation Strategies: Supporting European Climate Policy. Available at: www.cordis.lu/fp6/find-doc.htm#reporting.

Wynne, B. 2007. Risk as globalizing 'democratic' discourse? Framing subjects and citizens. In Science and citizens: Globalization and the challenge of engagement, edited by M. Leach, I. Scoones, and B. Wynne. London and New York: Zed Books.

INTERVIEWS

Frans Berkhout, Amsterdam/Holland 2008-10-28

Frank Beirmann, Lund/Sweden 2009-03-09

Ottmar Edenhofer, Potsdam/Germany 2007-09-10

Gunnar Eskeland, Potsdam/Germany 2007-09-12

Zsuzsa Flachner, Potsdam/Germany 2007-09-10

Alex Haxeltine, Bath//UK 2008-02-14

Constanze Hauge, Brussels/Belgium 2008-01-25, phone interview 2008-11-04

Mike Hulme, Lund/Sweden 2009-03-08

Harro van Asselt, Lund/Sweden 2009-03-09

Saskia Werners, Potsdam/Germany 2007-09-12

LINKING SCIENCE TO SOCIETAL BENEFITS: WHY, HOW AND WHEN?

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WHY AND WHEN SCIENCE SHOULD LINK TO SOCIETAL BENEFITS

Science (more broadly research and development (R&D)) projects rely on funding for support. Therefore the purpose of the project should match the purpose intended by the funder. When federally funded R&D is at hand, the purpose of projects must match the government's intent for R&D. Thus R&D should link to societal benefits when the government wants an R&D effort to meet a societal need.

Programs receiving federal funding indicate the priorities of the government. The U.S. federal budget maintains two discrete types of spending: mandatory and discretionary. Mandatory spending encompasses federally funded programs mandated by law. Because of the mandate, programs here are legally required to receive funding each year. Discretionary spending encompasses the rest of the federal budget. Converse to mandatory spending, discretionary spending is determined by open executive and legislative decisions that are not held to any legal mandate. As a result, discretionary spending reflects the ongoing top priorities of the U.S. federal government.

In the U.S., R&D is a federal priority. As R&D funding is not legally mandated, it falls within discretionary spending. Of total discretionary spending, R&D has consistently received at least 10% of federal funding over the past fifty years (see Figure 1). This indicates that R&D has long been a federal priority. Furthermore, most countries that are global leaders in R&D (see Figure 2) have increased their federal R&D funding over time (see Figure 3). This indicates that R&D is also a federal priority for countries across the world.

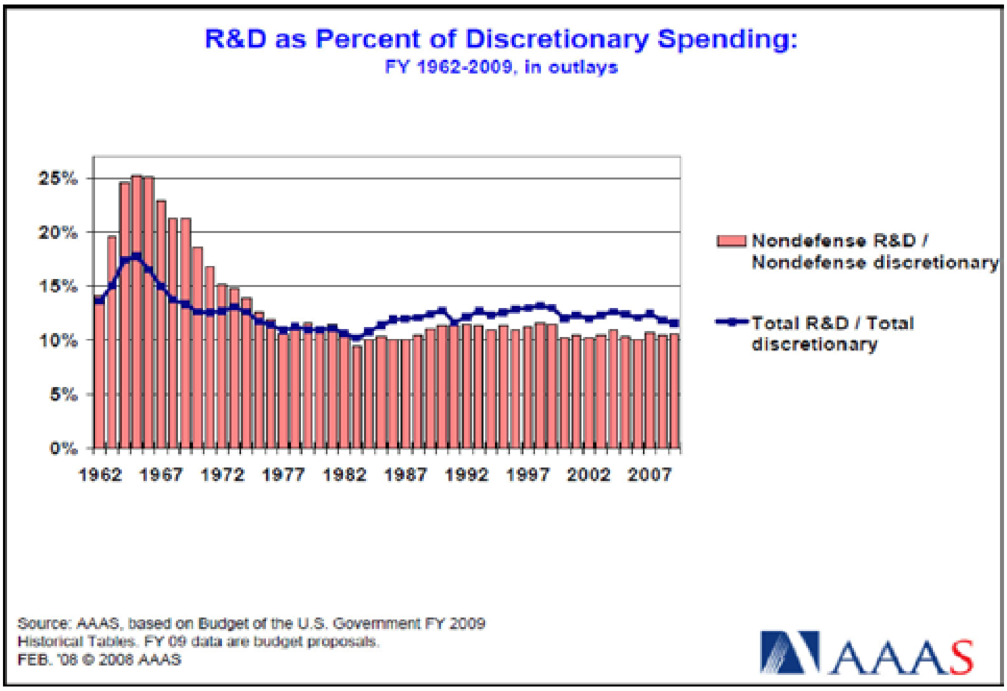

Figure 1

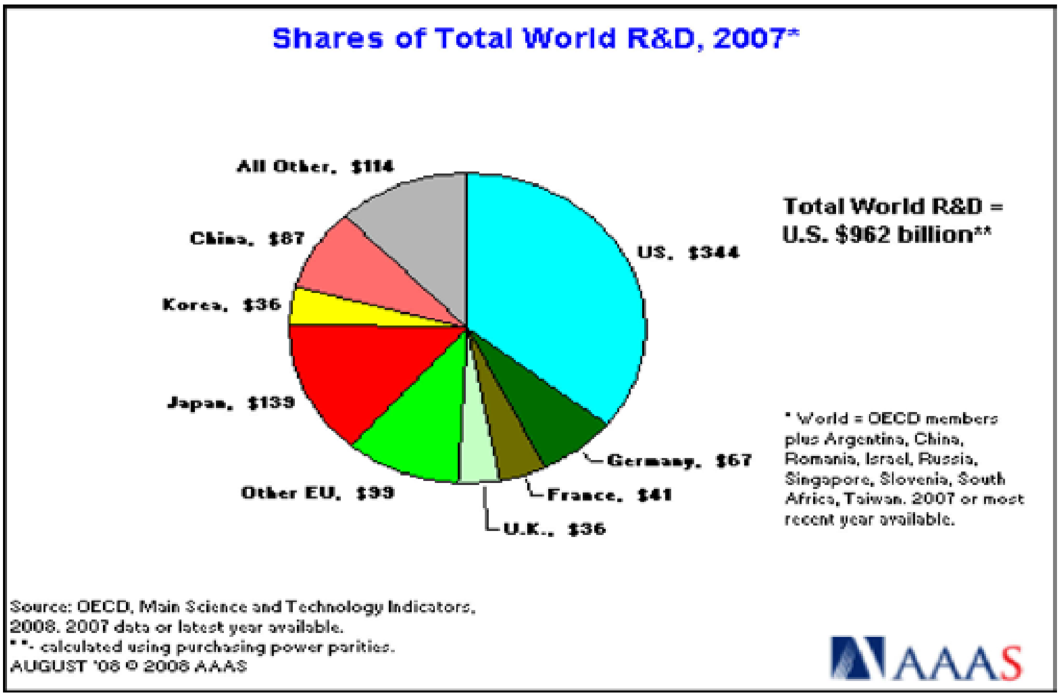

Figure 2

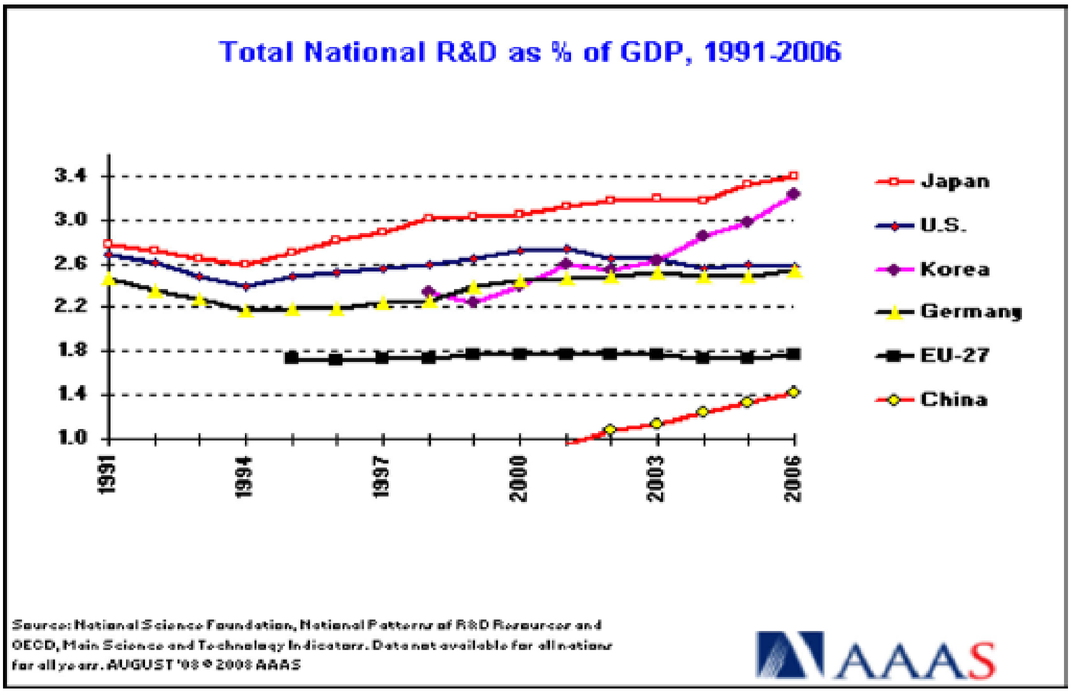

Figure 3

Within the R&D arena, programs vary in their purpose. Some programs exist with the purpose of advancing knowledge. Others exist with the purpose of filling specific societal needs such as improvements in health, the environment, or economic development. A great amount of discourse centers on the appropriate purpose of R&D. Further discourse explores managing an R&D portfolio among the two differing purposes. For a federal portfolio, what is the best balance of R&D programs of each purpose? Which R&D programs should focus on advancing knowledge? Which R&D programs should focus on meeting societal needs? How should R&D meet societal needs?

Five of seven leading R&D countries (including the European Union) maintain portfolios with a heavy emphasis on advancing knowledge (see Figure 4). Both the European and Japanese R&D portfolios prioritize advancing knowledge as the main purpose of R&D. This means that while

R&D is valued in these countries, its purpose of meeting any specific societal need is not as large a single priority as the purpose of advancing knowledge.

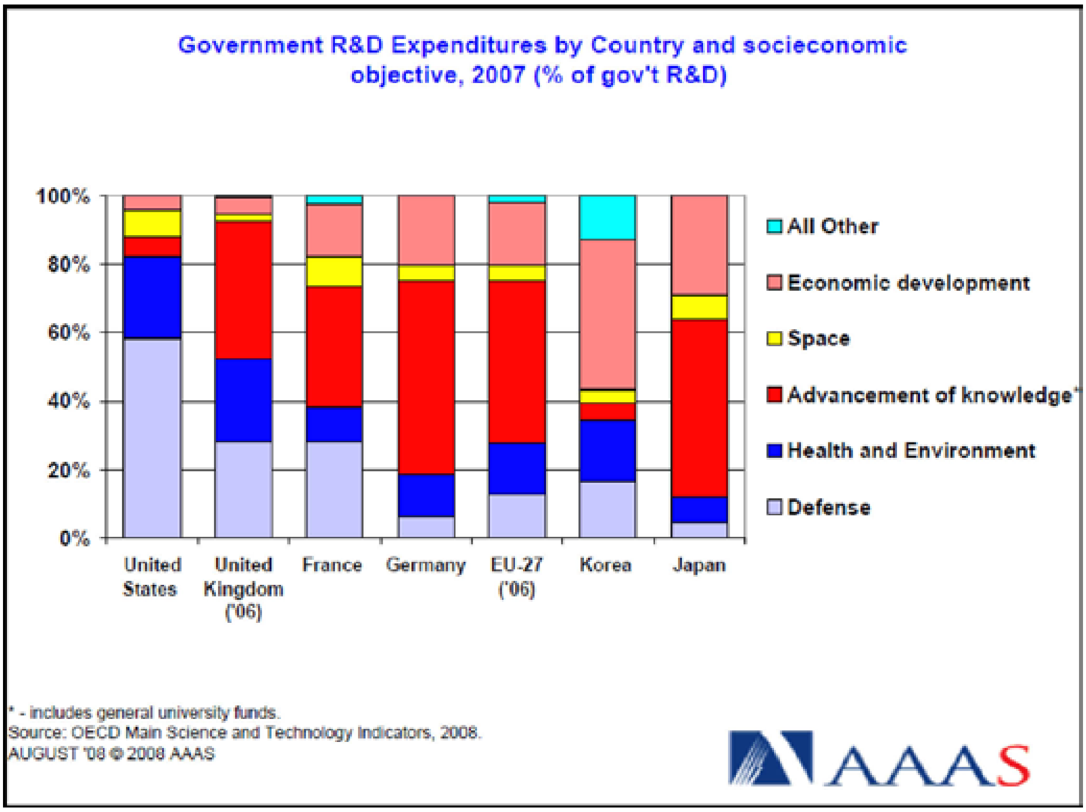

Figure 4

On the other hand, the U.S. values R&D with the purpose of meeting societal needs as opposed to the purpose of advancing knowledge. The U.S. allocates nearly 95% of R&D federal funding toward meeting specific societal needs (see Figure 4). While assessments differ in whether defense or health garner the greatest R&D funding (Figure 4 vs. Figure 5), it is clear that the U.S. prioritizes R&D that meets societal needs.

In the U.S., R&D is constantly expected to meet societal needs, especially in certain periods when a societal need emerges of great political significance and urgency. The corresponding spike in R&D funding reflects the expectation that R&D will answer this heightened need. For instance, the U.S. accelerated the space program in the 1960's to fulfill the goal of landing a man on the moon (as can be seen in the R&D funding increase in Figure 1). Similarly, since 2001 the U.S. has dramatically increased biomedical R&D funding (see Figure 5). This is largely due to the rising need for biosecurity after the September 11 attacks. Both of these periods provide examples for when the demand is even greater than normal for R&D to link to a specific societal need.

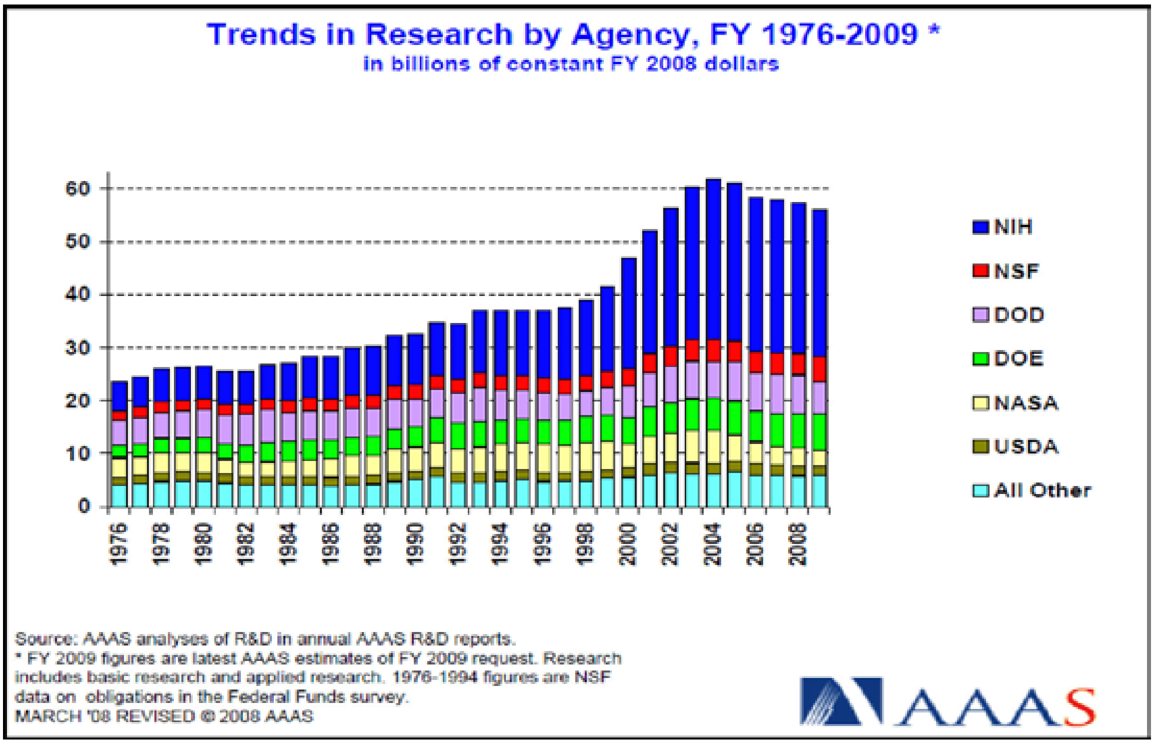

Figure 5

As stated, R&D should be linked to societal benefits when the government wants an R&D effort to meet a societal need. Based on the findings above (see Figure 4), the U.S. and Korean R&D programs should continuously fulfill societal needs, particularly for defense for the U.S. and economic development for Korea. On the other hand, based on government funding, the majority of European and Japanese R&D programs should be driven to advance knowledge more than meeting societal needs (see Figure 4).

HOW SCIENCE SHOULD LINK TO SOCIETAL BENEFITS

Ideally, countries will increasingly value R&D that meets societal needs. The purpose of advancing knowledge is meaningful. However, the advancement of knowledge when disconnected from any societal benefit offers less value to a society with growing needs and limited resources to fund any R&D. This circumstance - one that we face today, is better served by funding R&D that meets societal needs.

Linking R&D to societal benefits requires collaboration between the producers and users of research. The producers are the researchers that supply R&D. The users are the consumers of R&D such as the public, industry, and decision makers. Successfully linking R&D to societal benefits means the users receive R&D that meets their needs. This outcome results from a collaborative relationship relying on communication between researchers and users.

Boundary organizations consist of members who understand both the researcher and user sides. These organizations offer a unique mediating position to enhance collaboration between researchers and users. Users must convey what their needs are in order for researchers to align their R&D efforts accordingly. Often researchers are unaware of user needs. More so, users do not fully know their own needs. Users also remain unaware of the range of R&D efforts. Boundary organizations assist in the collaboration between researchers and users by exploring each group's unknowns, perspectives, and alternative options. This assistance streamlines the issues for each side and conveys such issues to the other side.

For example, the U.S. relies on The National Academies as boundary organizations between researchers and decision makers. The National Academies convene researchers to deliberate on issues in response to decision maker needs. The National Academies "perform an unparalleled public service by bringing together committees of experts in all areas of scientific and technological endeavor… to address critical national issues and give advice to the federal government and the public." [1] In understanding both sides, this boundary organization enhances the collaboration between researchers and users by exploring options and conveying each perspective to the other side.

Societal needs continue to grow and society continues to become increasingly dependent on science and technology. In some countries, these factors place greater expectations on R&D to fulfill such needs. Research and development can link successfully to societal benefits when both the researcher and user sides align their perspectives. A boundary organization can assist and enhance this process.

All figures courtesy of the American Association for the Advancement of Science. http://www.aaas.org/spp/rd/

1. The National Academies. http://www.nationalacademies.org/about/

SWEDEN WORKSHOP PAPER

by Mark Neff

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Science should be linked to societal outcomes because, as the problem statement mentioned, society pays for much of science, and making that connection more explicit can help to ensure that scientists address pressing knowledge needs. Ecological science, however, demonstrates another reason why it is critical to strengthen the links between research agendas and societal benefits/outcomes. The ecological scientists who were participants in my dissertation research uniformly stated that they thought ecological science should lead to social and environmental benefit, and in fact many evaluated the merits of potential research based on their estimation of the likelihood that those projects would lead to political changes that they preferred. For the most part, however, they did not recognize their preferred policies to be political preferences, but rather believed that they flowed directly from the science. To the extent that those scientists are correct about the impacts of their work, they usurp political power from democratic processes by choosing research with political intent.

The shared goal of hoping that ecological research would lead to societal and environmental benefit masked dissensus amongst this group of scientists in several major areas. First, there was significant disagreement about whom or what their work should benefit and what constitutes 'benefit.' Some people sought to further a political agenda that included a diminished presence and/or influence of people in some areas or across the globe. Others defined important research as that which would ensure that ecosystems provision people with the services they need in order to thrive. Second, the scientists with whom I interacted had differing ideas of how science does and should work with other elements in shaping policy and behavior. Some scientists felt that they could improve policy by amassing evidence that would compel the changes they saw as beneficial. Other scientists operated under the idea that research should be evaluated based on the likelihood that it would lead to sound theory. These folks believed that better ecological theories would bring about better decisions by policy makers and/or the public. Even these researchers, however, exercise political power when they choose to work on one set of theories versus another. Many stated, for example, that they felt that clarifying, building, and refining certain theories would have the effect of changing policy and behavior in their preferred ways.

The ecological scientists with whom I worked, in other words, evaluated research priorities based upon perceived links to outcomes that they as individuals desired. Many saw their job as ecological researchers to be creating research to convince others of the merits of particular policies and even lifestyles. The scientists' visions for what constitutes 'benefit' have significant ramifications for the rest of us. Additionally complicating the situation, without forums to openly discuss the goals of ecological research and the role or roles that their work plays in other societal processes, the scientists favored research that would (if their model of science's role in society were correct) work in opposition to the studies favored by other scientists. The ecologists felt that their work should push the world in certain directions, but they did not necessarily agree with one another about the directions in which the world should be pushed, nor about how science actually influences policy and behavior. Evaluating potential projects based on personal policy preferences not only hides important political considerations from democratic oversight but it also renders ecological science less effective in addressing existing knowledge needs both inside and outside of the scientific enterprise. By choosing research topics based on their belief that it will lead to specific policy and behavioral changes, they usurp power from democratic institutions rather than empowering those institutions. By not coordinating their efforts, however, they undermine their effectiveness in doing so. Placing research priority setting under greater democratic oversight would ensure that ecologists serve knowledge needs as effectively as possible and maintain the rightful status of democratic processes. All of the ecologists I interviewed saw their policy preferences as deriving from the science itself. If indeed that is true, better coordination of research priorities around societal needs would have the potential to lead more compelling messages to the public and policy makers because that coordination would prevent individual ecologists with different policy objectives from working against one another.

Also as identified in the problem statement, figuring out how to best organize science such that it is responsive to society while supporting longer-term knowledge needs remains a challenge. Science funding cycles strongly influence the types of research that scientists are able to do. Expecting rapid flexibility of the scientific enterprise to suit the latest political interests could seriously hamper scientists' ability to conduct important research. Also, scientists and their institutions need some funding predictability in order to develop the skill sets, knowledge base, and infrastructure necessary for a particular research pursuit. As such, there is a tension between flexibility to address new knowledge needs and the stability scientists need to conduct their work. Funding mechanisms need to balance these two concerns, which necessarily means either: A) devoting a lot more money to science to cover the latest whims of knowledge users at the same time as conducting potentially important long-term research (which I do not advocate), or B) partially isolating the funding mechanism from short term trends. Some funding could be allocated to addressing immediate needs, and then those research objectives could periodically be revisited to determine if they merit longer term, sustained funding. Creating oversight boards with democratic accountability through appointments with staggered terms could help to ensure some level of responsiveness to changing knowledge needs while ensuring that the agenda and priorities not dramatically shift with each political whim.

Attempting to coordinate research priorities between competing needs presents significant challenges, not least of which is the fact that many problems can alternatively or complimentarily be addressed from numerous angles. Different stakeholders in any given situation likely would favor different approaches. AIDS, for example, can be addressed through a variety of means, including social programs (e.g., education and condom distribution, and perhaps even poverty reduction), medical interventions (e.g., vaccine research, anti-retroviral drugs), improving condom design, amongst others. Within each of those broad-scale approaches there are countless potential research projects. Direct democracy would thus require more education about potential knowledge needs across diverse fields than is likely to occur. Oversight boards consisting of political appointees would fare better in effectively allocating funding between these efforts – as well as amongst other diseases and social problems. Those oversight boards would also benefit from connections to the research community in order to ensure that money is being put into those projects with potential for scientific success. Representatives serving the interests of researchers may be more productive in this role than researcher themselves because that may allow them broader perspective of which research areas are most promising.

CREATING USEFUL KNOWLEDGE: SOME REFLECTIONS ON CLIMATE SCIENCE POLICY RESEARCH IN THE SPARC PROGRAM[1]

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C***limate science policy*** decisions are those concerned with governing the climate science research enterprise, and can be distinguished from ***climate policy*** decisions, which are those made in anticipation of or in response to climate change (e.g., mitigation, adaptation). Of course, decisions made about climate science policy influence the knowledge that is available when making climate policy decisions, including knowledge of various alternative courses of action and their possible consequences. This short paper discusses the role of climate science policy in the context of climate policy.

Science policy decisions shape the conduct and output of climate research by guiding resource allocations, disciplinary and interdisciplinary priorities and methods, institutional design, human resources, and standards of evaluation. Science policy decisions are made in the face of uncertainty about the outcomes and utility of research. Over the past few decades, science policy decisions worldwide have allocated tens of billions of dollars, and mobilized thousands of scientists at hundreds of institutions, for climate research and assessment. A principal goal of these diverse activities has been the reduction of uncertainty about future climate behavior as an aid to decision makers.

The public investment in climate science is justified by the expectation that the resulting scientific knowledge will enable, support, and improve climate policy decisions—that is, decisions related to the impacts of climate on society, and of society on climate. It is the job of science policies to fulfill this expectation. But given that the funding of scientific research is almost always justified in terms of the potential for achieving beneficial societal outcomes, in pursuing a particular societal outcome, how can we know if one research portfolio is more likely than another to fulfill such expectations?

Society's ultimate success for responding to and preparing for climate change in the face of ongoing uncertainty thus hinges in no small part upon the relationship between science policy decisions and climate policy decisions. This relationship has been the explicit focus of our research over the past 5 years. Specifically we have focused on three aspects of this relationship:

1. How might climate research agendas be effectively developed and implemented in the context of stakeholder demands?

2. How might specific issues be prioritized given the multiple causes of global environmental change?

3. How can experts orient themselves in a highly contested political arena?

This short paper discusses our work in each of these areas:

1. SPARC is the Science Policy Assessment and Research on Climate program funded by the U.S. National Science Foundation at the University of Colorado and Arizona State University. An earlier version of this essay was presented at A Discussion paper prepared for the Workshop Science Policy Interface and Climate Change September 29th, 2008 Faculty Club, Utrecht University, the Netherlands

WORKSHOP COMMENTS

WORKSHOP COMMENTS

RECONCILING THE SUPPLY OF AND DEMAND FOR CLIMATE RESEARCH

We borrow from economics the concepts of "supply" and "demand" to discuss the relationship of scientific results and their use for several reasons. First, the analogy is straightforward. Decisions about science (i.e., science policy decisions) determine the composition and size of research portfolios that "supply" scientific results. People in various institutional and social settings who look to scientific information as an input to their decisions constitute a "demand" function for scientific results. Of course, the demand function can be complicated by many factors, e.g., sometimes a decision maker may not be aware of the existence of useful information or may misuse, or be prevented from using, potentially useful information. In other cases, necessary useful information may not exist or may not be accessible. But our key point is that there is reasonable conceptual clarity in distinguishing between people, institutions, and processes concerned with the supply of science, and those concerned with its use. Indeed, conventional notions of science policy exclusively embody decisions related to the former.

Nonetheless, a second reason for characterizing scientific research in terms of supply and demand is to recognize that, just as in economics, in the case of science, supply and demand are closely interrelated. Science policy decisions are not made in a vacuum but with some consideration or promise of societal needs and priorities. Thus there is a feedback between the (perceived) demand for science and the (perceived) characteristics of supply.

At the same time, we recognize the power and importance of scholarship over the past several decades that documents the complex manner in which science and society co-evolve, or are co-produced. The insights from such work dictate that categories such as "supply" and "demand" cannot be understood as conceptually discrete or fully coherent. Moreover, both supply of and demand for information emerge from complex networks of individuals and institutions with diverse incentives, capabilities, roles, and cultures. Yet in the face of such complexity, decisions about resource allocation, institutional design, program organization, and information dissemination have been and are still being made. That is, while notions of "supply" and "demand" may embody considerable complexity, they also represent something real and recognizable: on the one hand, people conducting research that has been justified in terms of particular societal outcomes, and on the other, people making decisions aimed at contributing to those outcomes.

Progress in climate science has led to important insights into climate processes and advances in forecasting capabilities, with direct implications for societal problems such as management of hydrologic, agricultural, and fisheries resources. In recent years, social science research has yielded new insights into the contexts and conditions under which society responds to climate—that is, the human dimensions of climate. In making science policy decisions, we often lack systematic knowledge about how the supply side for scientific information—the broad climate research portfolio, in essence—relates to the demand for information among climate decision makers, and to the capacity of decision makers to use the information they do receive. Indeed, research in human dimensions (and in decision sciences more generally) documents a pervasive mismatch between the information available to decision makers and the information used to support actual decisions.

Various longstanding frameworks for understanding policy decision contexts, ranging from Lindblom's "muddling through" to Lasswell's "central theory" to Simon's "bounded rationality" (e.g., 1969) suggest that the effective use of knowledge and tools by policy makers does not demand accurate quantification or reduction of uncertainty. In practice, policy makers often cope with and learn about uncertainties by first making decisions and then experiencing the outcomes. This insight has been formally applied to ecosystem management through the idea of adaptive management. Our own work on prediction and environmental decision making indicates that transparency, communication, and mutual understanding are more important to facilitating effective policy decisions than reduction of uncertainty.

From such perspectives, we have argued that a challenge for climate science policy is to develop knowledge and tools that can increase the ability of the supply side—climate information providers—to understand, respond to, and meet the diverse needs and capabilities of the demand side—the broad range of relevant decision makers. In 1999 the U.S. National Research Council acknowledged this priority when it observed that "the utility of [climate] forecasts can be increased by systematic efforts to bring scientific outputs and users' needs together."

In this context we have proposed a straightforward methodology of science policy research for assessing and reconciling the supply and demand functions for climate science information. The methodology consists of a demand side assessment, a supply side assessment, and a comparative overlay that assesses the match between supply and demand.

A demand side assessment focuses on the following question:

What information do decision makers want when making decisions about climate policy?

Research on the human dimensions of climate, though modestly funded over the past decade or so, has made important strides in characterizing the diverse users of climate information (be they local fisherman and farmers or national political leaders); the mechanisms for distributing climate information; the impacts of climate information on users and their institutions. This literature provides the necessary foundations for constructing a general classification of user types, capabilities, attributes, and information sources. This classification can then be tested and refined, using standard techniques such as case studies, facilitated workshops, surveys and focus groups. Given the breadth of potentially relevant stakeholders, such a demand side assessment needs to proceed by focusing on particular challenges or sectors, such as carbon cycle management, agriculture, ecosystems management, and hazard mitigation.

A supply side assessment focuses on the following question:

What knowledge is available from research on climate?

Perhaps surprisingly, the detailed characteristics of the supply side – the climate research community – are less well understood than those of the demand side. One reason for this of course is that over the past decade or so there has been some programmatic support for research on the users and uses of climate science, but no similar research on climate research itself. Potentially relevant climate science is conducted in diverse settings, including academic departments, autonomous research centers, government and private sector laboratories, each of which is characterized by particular cultures, incentives, constraints, opportunities, and funding sources. Understanding the supply function demands a comprehensive picture of these types of institutions in terms that are analogous to knowledge of the demand side, looking at organizational, political, and cultural, as well as technical, capabilities. Such a picture should emerge from analysis of documents describing research activities of relevant organizations, from bibliometric and content analysis of research articles produced by these organizations, and from workshops, focus groups, and interviews. The result is a taxonomy of suppliers, supply products, and research trajectories.

A comparative overlay evaluates the degree of correspondence between demand and supply

Assessments of supply and demand sides of climate information can then form the basis of a straightforward evaluation of how climate science research opportunities and patterns of information production match up with demand side information needs, capabilities, and patterns of information use. In essence, the goal is to develop a classification, or "map," of the supply

		Demand: Can User Benefit from Research?	
		YES	NO
Information Being Produced?	NO	Research agendas may be inappropriate.	Research agendas and user needs poorly matched.
	YES	Sophisticated users taking advantage of well-deployed research capabilities.	Unsophisticated users, institutional constraints, or other obstacles prevent information use.

side and overlay it on a comparably scaled "map" of the demand side. A key issue in the analysis has to do with expectations and capabilities. Do climate decision makers have reasonable expectations of what the science can deliver, and can they use available or potentially available information? Are scientists generating information that is appropriate to the institutional and policy contexts in which decision makers are acting? Useful classifications of supply and demand functions will pay particular attention to such questions. The results of this exercise can be tested and refined via stakeholder workshops and focus groups.

The 2 x 2 matrix shown to the right schematically illustrates the process. We call this the "missed opportunity" matrix because the upper left and lower right quadrants indicate where opportunities to connect science and decision-making have been missed. Areas of positive reinforcement (lower left) indicate effective resource allocation where empowered users are benefiting from relevant science. This situation is most likely to emerge when information users and producers are connected by, and interact through, a variety of feedback mechanisms. Areas of negative interference may indicate both opportunities and inefficiencies.

For example, if an assessment of demand reveals that certain classes of users could benefit from a type of information that is currently not available (upper left), then this is an opportunity—if provision of the information is scientifically, technologically, and institutionally feasible. Another possibility (lower right) would be that decision makers are not making use of existing information that could lead to improved decisions, as Callahan et al. (1999) documented for some regional hydrological forecasts. An important subset of the problem represented in this quadrant occurs when the interests of some groups, for political or socioeconomic reasons, are actually undermined because of the ability of other groups to make use of research results, as Lemos et al. (2002) demonstrated in a study of regional climate forecasts in northeast Brazil. Finally (upper right), research might not be relevant to the capabilities and needs of prospective users, as Rayner et al. (2002) demonstrated in their study of water managers.

The importance of institutional context

Decisions emerge within institutional contexts; such contexts, in turn, help to determine what types of information may be useful for decision-making. Supply and demand must ultimately be reconciled within science policy institutions, such as relevant government agencies, legislative committees, executive offices, non-governmental advisory groups, etc. Institutional attributes such as bureaucratic structure, budgeting, reporting requirements, and avenues of public input, combine with less tangible factors including the ideas and norms embedded within an institution, to drive decision-making about the conduct of research and the utility of results. How do research managers justify their decisions? Are those justifications consistent with the decisions that they actually make? What ideas or values are implicit in the analyses and patterns of decisions that the institution exhibits? What incentives determine how information is valued? These sorts of questions can be addressed through analysis of internal and public documents, interviews, and public statements about why and how research portfolios are developed. McNie (2007) provides a thorough discussion of what is known about how science policy institutions help to mediate the relationship of supply and demand.

Our analysis of the evolution of the climate science enterprise in the U.S. indicates that policy assumptions and political dynamics have largely kept the supply function insulated from the demand function except, in some cases, in the area of the international climate governance regime. Some modest experiments, notably the RISA (regional integrated sciences and assessment) program of the National Oceanographic and Atmospheric Administration, have sought to connect scientists and research agendas to particular user needs at the local level, but these lie outside the mainstream of the climate science enterprise (McNie 2008).

A research effort of the type sketched here can illuminate how well climate science supply and demand are aligned and who benefits from existing alignments. It can highlight current successes and failures in climate science policy, identify future opportunities for investment, and reveal institutional avenues for, and obstacles to, moving forward. The value of the method will in great part depend on how receptive (reconciliation) science policy makers are (demand) to learning from the results of such research (supply). Of course, knowledge generated about science policy is subject to the same pitfalls of irrelevance, insulation, neglect, mismatch, and misapplication that motivate our investigation in the first place. But the current context for science policy decision-making gives two reasons for optimism.

First, the fundamental justification for the public investment in climate science is its value for decision-making. This justification, repeated countless times in countless documents and public statements, thus defines a baseline for assessing accountability and measuring performance via the type of approach we have described here. Second, and of equal importance, the very process of implementing the method we describe will begin to create communication, reflection, and learning among science policy decision makers and various users and potential users of scientific information hitherto unconnected to the science policy arena. In other words, the research method itself creates feedbacks between supply and demand that will expand the constituencies and networks engaged in science policy discourse, expand the decision options available to science policy makers, and thus expand the opportunities to make climate science more "well ordered." Undoubtedly, institutional innovation would need to be a part of this process as well, given the scale and scope of the climate science enterprise and the potential user community.

SENSITIVITY ANALYSIS –RESEARCH TO SHOW WHERE POLICES CAN MAKE A DIFFERENCE

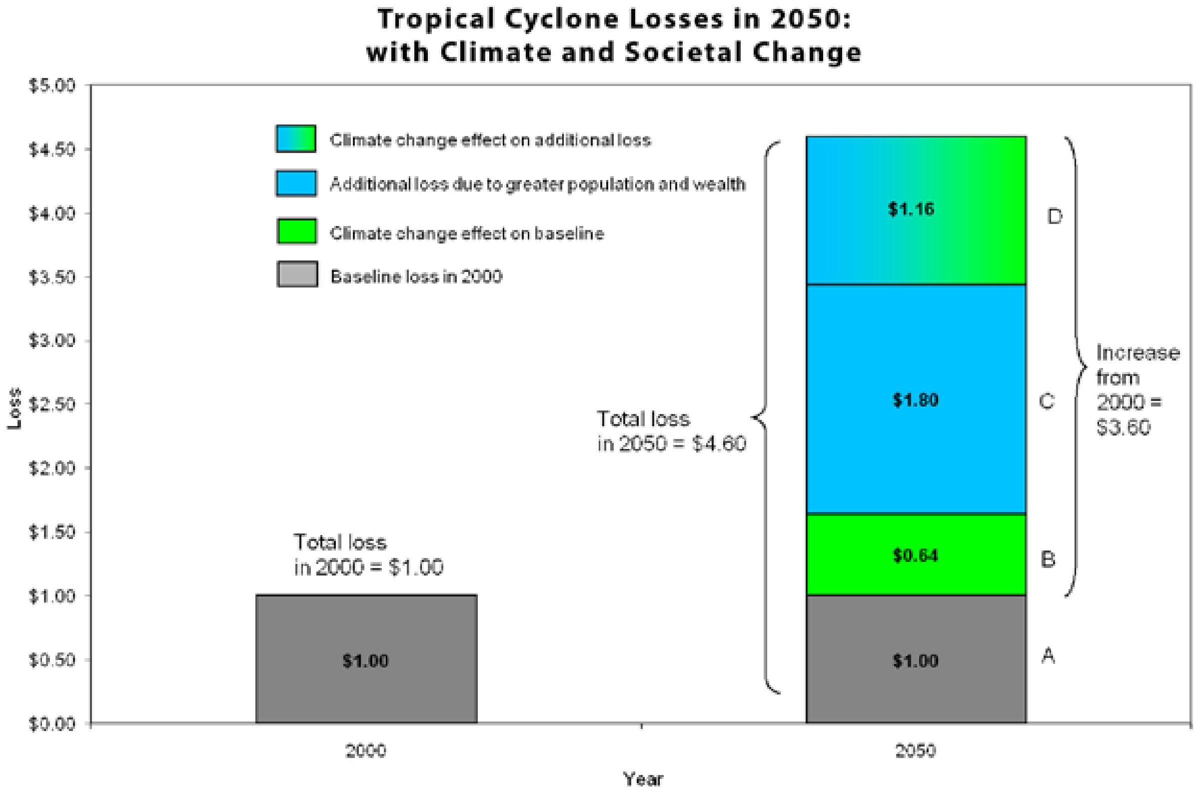
A key function of policy relevant research is to help policy makers identify where their actions can make a practical difference. The complexities of the real-world mean that the path from action to consequence can be difficult to anticipate with ineffectiveness and unintended consequences always a risk. Interdisciplinary research that identifies the sensitivities of outcomes to various actions can help to identify actions with outcomes robust to uncertainties and, critically, the role of assumptions in such analyses. Consider the following two examples, the first for a case of adaptation policy and the second on mitigation policy.

The Role of Adaptation in Disaster Policies

Scientists have warned that the costs of future disasters will likely increase due to more frequent and intense extreme events such as storms and floods. But this is only part of the reason for expecting increasing disaster losses. Society changes over time as well, with the net result being more property, people, and wealth in locations exposed to the impacts of extreme events. The image below dramatically illustrates changing patterns of development on Miami Beach. The implications for hurricane damage are obvious.

If policy makers wish to address the escalating costs of disasters then it is important to understand how various alternative actions are likely to influence future damages. Policy debates on climate change often focus on energy policies, but have more recently begun to acknowledge that adaptation must also be a part of the discussion, especially as related to disasters. The reason for this is simple. Damage from extreme events has a lot to do with patterns of human development, like the presence of trillions of dollars of property in beachfront locations. Development involves choices made every day in regions that experience extreme events, and these choices influence the nature of future disasters.

In our work we have sought to quantify the ***sensitivity*** of future losses to possible changes in climate and possible patterns of future development. Our goal has not been to predict the climate, development, or future losses, but instead to assess what factors are likely to be most responsible for the future costs of disasters across a wide range of assumptions, so that decision makers can identify policy actions robust to uncertainties.



Our research finds that the most important factors in the growing costs of disasters, at least to 2050, are patterns of development, under any scenario of climate change. The figure below illustrates this point in the context of global tropical cyclone (hurricane) damage. It shows that for every dollar in damages in 2000, under the assumptions of this scenario, we should expect $4.60 in damages in 2050, or an increase of $3.60. Half of this increase is due to development, whereas only a sixth is directly due to changes in climate. The overwhelming importance of societal change in driving future losses is robust across all scenarios of climate change, development, and damage projections, and in other scenarios the role of development is much greater. A robust conclusion from this work is that adaptation must be at the center of climate policies focused on extreme events.

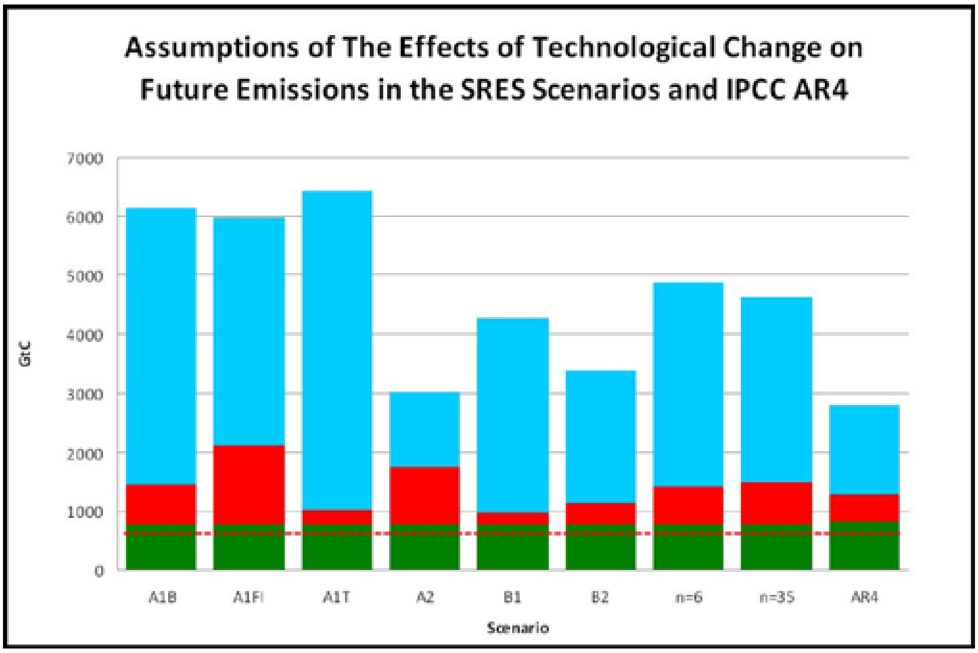
Because any changes to energy policies resulting in lower emissions of greenhouse gases will take many decades to have a discernible effect on the climate system, and because the exact relationship of greenhouse gases and patterns of extreme events remains somewhat uncertain and contested, these finding should be welcomed by decision makers. What these research results mean is that we have considerable ability to influence the nature of future economic losses from disasters by focusing on choices that we make in the development of regions exposed to extreme events. These results mean that scientific uncertainty about the pace and magnitude of climate change need not stand in the way of decisions that might influence the growing rate of disaster losses around the world.

The Role of Technological Innovation in Mitigation Policy

All estimates of the magnitude of future emissions reductions (and associated costs) consistent with various stabilization trajectories require some estimate of the amount of future emissions. Projections of future emissions in turn depend upon assumptions of technological innovations that will allow the global economy to grow while becoming more efficient, as occurred during 1980-2000. Identifying the role of these assumptions in our policy analysis can show how significantly policy arguments depend upon them.

In April, 2007, 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.

The figure below shows a range of "automatic" emissions reductions (blue) in the scenarios used by the Intergovernmental Panel on Climate Change (IPCC) in its 4th Assessment report. Total cumulative emissions to 2100 associated with a "frozen-technology" baseline (i.e., the technologies available presently) are shown for: six individual scenarios, the means of these scenarios, and for all 35 IPCC scenarios, and the median of the scenario set (AR4). Additional emission reductions will have to be achieved by climate policy (red), assuming carbon-dioxide stabilization at about 500 parts per million (ppm), leaving allowed emissions for this stabilization target (green, the dashed red line shows the same for a 450 ppm target).



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 and cost more. 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.

We argue that analysts and policy makers alike 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 saw 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.

THE ROLES OF THE RESEARCHER IN HIGHLY POLITICIZED CONTEXTS

When former US Vice President Al Gore (2007) testified before the United States Congress in 2007 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. in his words, "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 book ***The Honest Broker: Making Sense of Science in Policy and Politics*** (Cambridge University Press, 2007), I describe various ways that an expert (e.g., a doctor) might interact with a decision maker (e.g., a parent) in ways that lead to desirable outcomes (e.g., a healthy child). Experts therefore 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 point of departure to illustrate the four different roles for experts in decision making that are discussed in The Honest Broker. The four categories are very much ideal types – the real world is more complicated, but nonetheless I do argue that they help to clarify roles and responsibilities that might be taken by experts seeking to inform decision making.

- **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 aspirin 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 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 does the overlap of science and values occur in practice?

The analogy suggested by Al Gore is conceptually simplistic, with few actors, narrow relevant knowledge, and easily identified desired outcomes. The decision makers are not facing a "fire hose" of knowledge, nor are there conflicting interests opposed to each other. But even in this simplistic case, there can be hints of the complexities facing advisors to decision makers.

Consider the Pure Scientist or Science Arbiter as described above. How would you view your doctor's advice to take ibuprofen if you learned that she had received $50,000 last year from a large company that sells ibuprofen? Or upon hearing advice to perhaps forgo medicine for this particular ailment, what if you learned that she happened to be an active member 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 she prescribed? 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 (transdisciplinary) 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 reality, the Pure Scientist may exist more as historical legend than anywhere else.) In situations of values conflict or when scientific certainty is contested, that is to say most every political issue involving scientific or technical considerations, 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. Stealth issue advocacy occurs when one seeks to reduce the scope of choice available to decision makers but couches those actions in terms of serving as an Pure Scientist or Science Arbiter (e.g., "The science tells us that we must act . . .").

So your child is sick and you take him 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 her 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 that I seek to present in 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 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.

CONCLUSION

We believe that careful attention to (a) the supply of and demand for research, (b) the sensitivity of outcomes to the integrated factors shaping human-environment systems (as well as sensitivities to simplifying assumptions), and (c) the political role of expert advisors can help provide useful tools to assist in the creation and implementation of effective science policies.

LINKING SCIENCE TO SOCIETAL BENEFITS: WHY, HOW AND WHEN?

SOME REFLECTIONS ON THE THEME OF THE WORKSHOP

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WORKSHOP COMMENTS

This paper aims at discussing public engagement in science from the point of view of two topical issues in focus of public attention and debate: genetically modified organisms (GMOs) and climate change. I will bring out a few reflections which originate from studies of public understanding of these issues. Hopefully these brief reflections could serve as a starting point for further discussion at the workshop.

I will start by discussing the issue of genetically modified (GM) food, which has caused controversies between scientists, the industry, consumer and environmental organisations and the general public for more than a decade. It is plausible that some of the strong reactions could have been avoided if there had been more transparency from the part of the scientific society and the GMO industry (Grove-White et al 2000; Marris 2002). The reactions against GM food have been explained as a matter of public mistrust in societal actors such as scientists, industry representatives, politicians and the media (Wagner et al 2001; Wibeck & Asplund 2008). When GMOs were introduced in Europe, science communication was from the outset based on a deficit model, assuming that lay people's scepticism would seize if only their knowledge increased. In addition, communication of scientific uncertainties tended to be based on a so-called 'separation model' for communication (Wibeck 2009), which means that the expert arena was separated from other societal arenas in evaluating scientific uncertainties related to gene technology. The public and policy makers were perceived by experts as lacking the time, interest and knowledge to reflect upon uncertainties. Hence, the experts saw as their task to communicate a clear message depicted in black and white (Grove-White et al 2000). However, several scholars have argued for the need to expose the limits of scientific knowledge to increase trust between actors operating in the expert, policy, and public arenas. If experts present complex scientific information as 'facts', while neglecting to communicate scientific uncertainty, the result may be mistrust on the part of the public, since information is perceived as oversimplified (Gross 2007; Gross & Hoffman-Riem 2005; Grove-White et al 2000; Hoffman-Riem & Wynne 2002). By contrast, early public engagement in the GMO could have enabled uncertainties to be openly discussed according to a so-called 'integration model' (Wibeck 2009). In the integration model uncertainties are transparently discussed in the expert as well as the public and the policy arenas. In this model, lay people are treated as active co-constructors of knowledge rather than as passive recipients. The integration model bears many resemblances with Mode 2 science (e.g. Gibbons et al 1994) and post-normal science (Funtowicz & Ravetz 1993), and presupposes that an 'extended peer community' of different stakeholders is involved in evaluating and discussing the consequences of uncertainty.

The GMO issue appears as a relatively straightforward case where increased public engagement in science would have been helpful, especially if an 'upstream' approach with early engagement would have been used. An 'upstream', or early, public engagement could, according to its proponents, forge a democratic approach to the governance of science (Rogers-Hayden and Pidgeon 2007). Upstream dialogue could also enhance trust in the policy-making process and generate better quality outcomes (ibid.). Nevertheless, it has also been pointed out that there is a risk that calls for upstream engagement in science may end up as yet an expression of the deficit model of science communication, only with the exception that the focus is moved from a perceived deficit of public understanding of science to a deficit of public engagement with science (ibid.).

The scientific community would probably have gained more trust from society if ethical, legal and social aspects of gene technology had been openly discussed at an early stage (Rider 2000). My impression of some discussions that I have attended between representatives of the scientific community is, however, that the issue of trust is often not framed as a question of mutual trust – it is rather a question of how to increase society's trust in science, not of scientists trusting the public to be able to ask relevant questions, handle complexities and produce subtle lines of argument.

Another societal issue that has spurred discussion about public engagement in science and policy is climate change. It has been emphasised that climate change is among those complex issues where 'facts are uncertain, values in dispute, stakes high, and decisions urgent' (Funtowicz & Ravetz 1999:1). This would speak in favour of a 'post-normal' scientific approach, involving an 'extended peer community' in evaluating the quality of scientific information and organizing it into relevant categories (ibid.). Along similar lines, international policy documents have also emphasised the need to increase the level of public participation in climate policy issues (cf. the Aarhus Convention 1998, UNFCCC 1992). In this context, I would like to highlight the obvious fact that even though social scientists often speak of 'public understanding' and 'public engagement' in science, 'the public' is not a coherent target group. Mine and others' experience of recruiting lay people to focus group studies is that a specific segment of the public is easily recruited. This is the decided public with strong views on the topics being addressed by the research, or special interest in social issues and research generally. On the other hand, methods such as focus groups, which could be used for engaging an extended peer community in science, have been marketed as especially well suited to incorporate the views of underrepresented groups in research. I believe that there is much to be gained from trying to include marginalised groups in the scientific process, especially if the aim is to actually engage an extended peer community early on in the design of a project. However, it may take more effort to convince participants from underrepresented groups that their views are important and that they can participate without being professional experts in the area of study. If such groups are recruited, it is really important to the research participants get feedback on the results of the process. In my experience, social science far too often stresses the importance of listening to people's voices when recruiting participants, but thereafter the feedback to the participants is very poor. Instead of building trust, such negligence risks leading to increased mistrust between the public and the scientific community.

I argue that in order to facilitate trust-building between scientists and other societal actors, it is important for scientists to recognize the ability of lay people to reflect on complex scientific phenomena, although be it from an everyday perspective. I also believe that it is helpful to base environmental science communication on knowledge of how everyday representations of complex environmental issues are formed and withheld. Social psychologists have analysed how complex scientific knowledge over time transforms into socially shared common sense knowledge, so called social representations (e.g. Moscovici 1984, Marková et al 2007). Such studies start from the assumption that ideologies, opinions, attitudes, emotions and value premises form part of a complex argumentative web made manifest (and at the same time established, changed and reinforced) and used as a resource by the interacting participants in a discursive process. In contrast to research inspired by the deficit model of science communication, projects based on the theory of social representations emphasize the power and dynamics of lay thinking and arguing, and the ability of the 'ordinary person' to handle complexities and produce subtle lines of argument (e.g. Billig 1993).

Nevertheless, researching public understanding of climate change from the perspective of social representations theory confronts the researcher with new dilemmas. The study of joint meaning-making in action means that the participants construct new knowledge during the data collection process. Even the researcher is involved in this process. As a moderator or interviewer, the researcher is not an objective recorder of attitudes, but an active part in the co-construction of meaning taking place in the interview situation. Far from assuming that stable attitudes could be 'tapped off' from the study subjects to be reported in an objective way, the creation of focus groups, or 'thinking societies in miniature' (Jovchelovitch 2001), gives room for interaction between interviewees which may result in learning processes potentially (at least partly) changing their opinions. Thus, the crucial question in analysing data changes from 'what are the interviewees' opinions?' to 'what do they learn?' or 'how are social representations of e.g. climate change formed, maintained and modified throughout the study'?

The social sciences may contribute with important insights into how different stakeholder groups, including segments of the public, make sense of and react to complex environmental issues, such as climate change, or the deliberate release of GMOs. These insights could feed into the design of fora for communication between science and other societal actors and into processes of public engagement in science production. Nevertheless, further discussion is needed as to how to engage the broader public in science-related matters and how to facilitate mutual trust-building between science and the public. My hope for the workshop is that our discussions will lead us some steps forward in this direction.

REFERENCES

Aarhus Convention on access to information, public participation in decision-making and access to justice in environmental matters (1998). URL: http://www.unece.org/env/pp/documents/cep43e.pdf

Billig, M. (1996). Arguing and Thinking. A Rhetorical Approach to Social Psychology. 2nd ed. Cambridge: Cambridge University Press.

Funtowicz, S. & Ravetz, J. (1993) Science for the post-normal age, Futures, 25, pp. 739–55.

Funtowicz, S. & Ravetz, J. (1999) Post-normal science: environmental policy under conditions of complexity. URL: http://www.nusap.net/sections.php?op=printpage&artid=13.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. & Trow, M. (1994) The new production of knowledge: the dynamics of science and research in contemporary societies (London, Sage).

Gross, M. (2007) Communicating ignorance and the development of post-mining landscapes. Science Communication, 29, pp. 264-270.

Gross, M., & Hoffmann-Riem, H. (2005) Ecological restoration as a real-world experiment: designing robust implementation strategies in an urban environment, Public Understanding of Science, 14, pp. 269-284.

Grove-White, R, Macnaghten, P & Wynne, B. (2000) Wising up. The public and new technologies. The Centre for the Study of Environmental Change (Lancaster, Lancaster University).

Hoffmann-Riem, H., & Wynne, B. (2002). In risk assessment, one has to admit ignorance, Nature, 416, p. 123

Jovchelovitch, S (2001), Contextualising focus groups: understanding groups and cultures. Paper prepared for the V Meeting of the Group 'Conversation et language', Laboratoire Européen de Psychologie Social, Paris.

Marková, I., Grossen, M., Linell, P. & Salazar Orvig, A. (2007) Dialogue in Focus Groups: Exploring Socially Shared Knowledge (London, Equinox).

Marris, C., Wynne, B., Simmons, P. & Weldon, S. (2002), Public Perceptions of Agricultural Biotechnologies in Europe. Final Report of the Pabe Research project. http://www.lancs.ac.uk/depts/ieppp/pabe/docs.htm

Moscovici, S., (1984), 'The phenomenon of social representations'. In: Farr, R. and Moscovici, S. (eds.) Social Representations. Cambridge: Cambrigde University Press.

Rider, S. (ed.) (2000), Report on Research concerning Ethical, Legal and Social Aspects of Genome Research. Uppsala: Universitetstryckeriet.

Rogers-Hayden, T. and Pidgeon, N., (2007), 'Moving engagement "upstream"? Nanotechnologies and the Royal Society and Royal Academy of Engineering's inquiry' Public Understanding of Science, 16, 345-364.

United Nations Framework Convention of Climate Change (UNFCCC) (1992). URL: http://unfccc.int/resource/docs/convkp/conveng.pdf

Wagner, W. et al (2001), "Nature in disorder: The troubled public of biotechnology". In: Gaskell, G. & Bauer, M. (eds.) Biotechnology 1996-2000: the years of controversy. London: Science Museum.

Wibeck, V & Asplund, T (2008), "Focus groups". In: Moses, V. et al, Do European Consumers buy GM Foods? Final report from the CONSUMERCHOICE project. Available at: www.kcl.ac.uk/consumerchoice.

Wibeck, V (2009), "Communicating uncertainty: Models for communication and the role of science in the assessment of environmental goal achievement". Journal of Environmental Policy and Planning, 11, 87-102.

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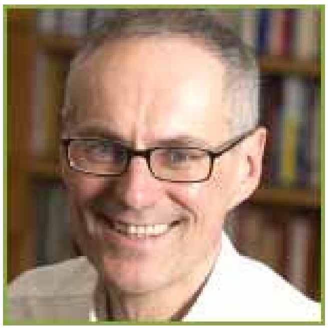

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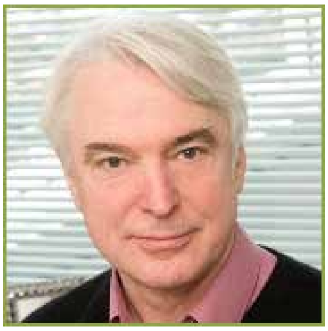

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AN INTERNATIONAL WORKSHOP AT THE CENTRE FOR CLIMATE SCIENCE AND POLICY RESEARCH

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