Accountable to whom, when and how? Learning from science policy decisions and research practice in the European ADAM project

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Introduction

The role of science in society has been widely debated in recent years. In an age when expert knowledge is "tightly woven into the very fabric of our existence" (Fischer, 1990, p. 13), 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 & Ravetz 1993), citizen science (Irwin 1994), Mode 2 (Gibbons et al. 1994) and co-production (Jasanoff 2004, Lemos & Morehouse 2005) are just some of the many concepts that characterise this new social contract for science. Of central importance 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 democratically accountable through direct engagement with societal context.

In this broad and diverse literature, some scholars have advanced social utility as the main reason for engaging actors outside science in the research process. In order to increase science's problem-solving capacity and ability to deliver desired societal ends, many scholars have suggested that knowledge users in society have to have a say in the setting of research portfolios. Hence, the accountability of science has been extended to those groups in society that are expected to benefit from scientific research efforts. In this paper we discuss how this

extended accountability can be interpreted and what it implies for research practice. Although there seems to be a general agreement among scholars of science and society that affected stakeholders and/or members of the public should be involved in the governance of science, there is still little guidance as to whom to involve, how and when. In an attempt to address these questions, we draw upon a case study of the European Union research project ADAM (Adaptation and Mitigation Strategies in Support of European Climate Policy).

The ADAM project in interesting in this context since it was designed with the ultimate aim of being 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 expectations tied to this 'flagship' of the EU's Sixth Framework Programme (FP6) have consequently been high. While close interaction with relevant stakeholders in the European Commission (EC) has been central to the ADAM project, the involved scientists have since the project's inception in March 2006 been caught up in a difficult balancing act between the EC's calls for short-term policy advice and their own ambitions to offer independent and innovative climate policy appraisals. Ultimately, the ADAM story raises questions about the accountability of science in an age where co-production is promoted as the guiding principle for science policy decisions and research practice. How can we hold science accountable to the diverse knowledge needs of societal stakeholders? Within what time frames does it make sense to assess the accountability of science? How far does the democratic responsibility of science extend? In this paper we address these questions in the following manner.

First, we put the ADAM quest for social utility in a theoretical context. We discuss the new social contract for science advanced in the science and society literature and how this normative shift in the science-society relationship has affected the understanding of scientific accountability. Second, we introduce the ADAM project and discuss how it has been organised to accommodate calls for democratic accountability in its research efforts. We base our analysis upon 18 semi-structured interviews with ADAM researchers, and participant observations at 8 different ADAM meetings and workshops during the period January 2008 to March 2009. Finally, we discuss lessons learned from the ADAM project and what they tell us about the new social contract for science. Although efforts to link the practice of science to democratic politics may appear appealing as normative theoretical ideal, our study suggests that it is far more complex when translated into practice. To involve affected stakeholders in the research process is not only a challenging and time consuming task. The quest for direct

and immediate utility central to such interaction may also inhibit academia's scope for critical reflection and intellectual innovation. While the ADAM story indeed can be interpreted as a critique of efforts to link science to democratic politics, it also prompts scholars of science and society to specify the principles against which the democratic accountability of science should be assessed.

A new social contract for science

A large literature has questioned the adequacy of the so-called 'linear model' of science, which ties societal progress to the pursuit of basic research performed without thought of practical ends (Pielke 2007). In exchange for autonomy and government funds, curiosity-driven and self-regulating research will, according to this model, deliver discoveries and technological innovations necessary for a prospering society (Polanyi 1962). While this idealised science-society relationship has underpinned Western science policy in the post World War II era, most contemporary scholars of science and society agree that its linear 'science speaking truth to power' model is hopelessly outdated for at least two reasons.

First, the view of science as a neutral truth-speaker standing apart from the social context in which its knowledge is produced and used has eroded during the past decades. Many years of social constructivist scholarship has taught us that knowledge and beliefs about the natural world are closely linked to the social world in which they are embedded. As argued by Jasanoff (2005:22), the material and cognitive products of science "embody beliefs not only about how the world *is*, but also how it *ought* to be". Hence, the received view among scholars of science and society holds that science cannot be regarded as an autonomous activity cleanly demarcated from society, culture or politics. Science and society rest upon the very same foundation; science is a part of, not apart from, society (Nowotny et al. 2002: 2, Latour 2004). If no firm lines can be drawn between the scientific and the social, the adequacy of the linear model is challenged. Scientific experts can no longer claim a privileged position – a "view from nowhere" – from which context-free reason trickles down to the broader society (Shapin 1998). Rather, the post-positivist understanding of science as deeply entrenched invites us to challenge the neutrality of specialised knowledge and reflect upon how authoritative knowledge is constructed in relation to social values and political motives (Davis and Burgess 2004, Jasanoff 2003b).

This epistemological rethinking of the science-society relationship leads to the second and more normative critique of the linear model. Along with the attentiveness to the politics of science, we have seen a growing concern that science in the aggregate has failed to live up to its promise to work for the benefit of society as a whole (Felt and Wynne 2007, Leach et al. 2007, Brunner and Ascher 1992). Critical scholars have pointed out that science too often serves an ideological function of legitimising the interests and decisions of societal elites (Fischer 1990, 2005). By framing social problems in scientific terms, issues of meaning are often closed from public debate ruling out alternative political visions and adjustments in the social order (Wynne 2007). Although scientists themselves may not deliberately contribute to this instrumental use of their research, there is today a mounting pressure to, in the words of Jasanoff (2003a: 240); "make explicit the normative that lurks within the technical" and to hold science accountable for the implicit social choices built into certain research agendas and priorities (Lemos and Dilling 2007). In debates over science and society there is consequently a distinct shift in the understanding of scientific accountability underway.

Following the logic of the linear model, the accountability of science has traditionally been restricted to "accounting for the use of public funds" (Jacob 2006). The content and quality of the research has not been included in this public control function. Rather, peer review has been the traditional instrument used by scientists to secure the credibility, originality and interest of reported results (Jasanoff 2003). However, in an age when the linear model of science is challenged, scholars and practitioners alike have sought to move beyond peer review to other means of aligning the accountability of science with democratic politics. In liberal democratic societies, accountability denotes modalities of oversight and constraint on the exercise of state power (Mason 2005). According to Mason (2005, p. 3) democratic accountability "refers to the capacity of citizens to keep in check those who possess public authority through mechanisms compelling these office-holders to give reasons for their actions and, when performance is deemed unsatisfactory, to sanction them through media-enabled protests, legal challenges or, more routinely, the withdrawal of electoral support for the governing party." Hence, answerability and redress emerge as two core elements of democratic accountability. Public actors should answer for their (in)actions according to a set of standards, and be subject to sanctions if they breach such standards (Mason 2008, p. 10).

Efforts to extend this democratic notion of accountability to science often assume that citizens or societal knowledge users should have a say in the governance of science, as all public

support for science is justified in terms of societal benefit. Such involvement will both compel scientists to justify the social utility of their research and empower the public to shape research portfolios according to those justifications as well as the ultimate outcomes of research. Redress in terms of legal challenges or the loss of electoral support may only rarely apply to science, even when citizens question the utility of resulting research. However, by letting "society speak back to science" (Nowotny et al. 2002), scholars and practitioners alike hope to make science aware of its public constituents and to act within parameters that are continually open to public review (Jasanoff 2003, p. 162). Broader participation in science policy decisions and research practice is often seen as key to such democratic accountability, and ultimately, a scientific enterprise more responsive to democratic imperatives.

In their famous account of post-normal science, Funtowicz and Ravetz (1992) envisioned extended peer communities, involving stakeholders affected by the use of science, taking part in the scientific quality control process. The participation of such extended peers would not only offer new perspectives and forms of knowing to policy problems involving large uncertainty and high decision stakes. By exposing the normative presuppositions underpinning science-based judgments, they would also increase the democratic accountability of scientific expertise (Funtowicz and Ravetz 1992). Going beyond the quality of scientific results, Gibbons et al. (1994) have identified and advocated a new mode of knowledge production (known as Mode 2, in contrast to Mode 1, essentially the "linear model") performed in direct collaboration between researchers and a range of potential users and stakeholders. Unlike the linear model of science that draws legitimacy from scientific independence, Mode 2 science gains "social robustness" from its societal embeddedness. Produced in the context of application, science is in this model confronted with the needs of a highly heterogeneous public and will thus be compelled to work for public ends (Nowotny et al. 2002). Another narrative with a similar message is the co-production discourse. While developed as a philosophical concept to describe the close links between scientific knowledge and social order (cf. Jasanoff 2004), co-production has also been used to denote the everyday interaction between scientists, policy-makers and the public in the production of "usable knowledge" (Lemos and Morehouse 2005, p. 59).

Central to such visions of science is the idea that knowledge produced in close collaboration with non-academic actors will be put under careful public scrutiny and hereby better accommodate the broad set of knowledge needs and concerns in society. Despite the

widespread scholarly support for this new social contract for science, remarkable little attention has been given to practical and institutional aspects of gearing science towards public values (cf. Bozeman and Sarewitz, 2008). Which user needs or public concerns to include in the governance of science is seldom explicitly discussed, nor how to best involve concerned actors in the science policy decisions and research practice. Some scholars approach citizens as the main agents of accountability (Felt and Wynne 2007, Jasanoff 2005), others stakeholders or strategic user groups (Sarewitz and Pielke 2003, Lemos and Morehouse 2005). While many agree that public oversight should occur "upstream" when central research priorities are made, the democratic standards for such oversight often remain unspecified at a level of detail necessary to guide implementation. Moreover, the temporal dimensions of scientific accountability are seldom discussed. Within which time frames should science be held accountable to the knowledge needs in society? As suggested by Sarewitz and Pielke (2003, p. 7), fundamental achievements in knowledge often have broad application beyond anything that could be anticipated if the time scale is long enough. However, such links between inquiry and utility may appear as too serendipitous to inform science policy decisions and research practice.

Ultimately, all of these practical concerns touch upon the fundamental question of how far the democratic responsibility of science extends. This is a question that was raised by Collins and Evans (2003) in a highly criticised but nonetheless important article. During the six years that have passed since then, scholars of science and society have continued to debate and defend efforts to link science to democratic politics. Although the governance of science has turned into a laboratory for public engagement and the empirical understanding of such engagement is increasing, the academic debate has to date not offered a satisfactory response to Collin's and Evan's "problem of extension". This paper will by no means be able to fill this gap. However, through our study of the ADAM project we seek to highlight the importance of specified principles of accountability. In order to strengthen the links between science and democratic politics, we need to know against which standards the accountability of science should be assessed.

The ADAM project

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).

ADAM represents an explicit effort to integrate European research capacity on climate change mitigation and adaptation. As spelled out in the project proposal (Hulme 2004), the project aims to offer a better understanding of the synergies, trade-offs and conflicts that exist between adaptation and mitigation policies at multiple scales. To that end ADAM has involved researchers from 26 universities and research institutes across Europe in a 3,5 year collaboration, starting in March 2006. The total project budget for these 3,5 years has been 18,2 million EUR, of which the EC has contributed 12 million. 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) has also taken great interest in ADAM. As indicated by the project title, ADAM sets out to support EU climate policy development in a time when the UN negotiations on a post-2012 climate policy regime is under negotiation. More specifically, the core objectives of ADAM are (Hulme 2004, p. 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.
- 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.

- 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 has been divided into a number of work packages (see Table 1). The *Scenario Domain* has been involved in the making of four climate scenarios that will guide the ADAM analysis. The scenarios span 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* has focused on the costs and effectiveness of different mitigation options at the EU level. This domain has also addressed interactions between the EU and other world regions through international trade, development aid, technology transfer, and trade of used products and investment goods. The *Adaptation Domain* has, in turn, analysed Europe's vulnerability to climate change. Social, technical and environmental factors that influence adaptive capacity have been in focus. Finally, the *Policy Appraisal Domain* has been engaged in the development of the 'Policy Appraisal Framework' – a new method for assessing long-term strategic policy options.

Table 1 ADAM work packages

Work package	**Objectives, research tasks**
A1: Assessing Potential Impacts and Adaptive Capacity	Conceptual basis for analysing vulnerability, meta-analysis of existing European vulnerability studies, vulnerability atlas, analyse vulnerability impact of European climate policies
A2: Coping with Extremes	Analyse cost estimates for adaptation, disaster damage, limits to European ability to adapt, European responsibility to assist developing countries to adapt
M1: Mitigation at the European Level	Assess costs and impacts of ambitious mitigation scenarios, effects on the European economy, employment, trade-offs between mitigation and adaptation policies
M2: Mitigation at the Global Level	Analyse and propose mitigation options for the post-2012 regime, highlight channels of interaction between EU and other regions, propose, renewable energy technologies that can improve European competitiveness
P1: Development of a Policy Appraisal Framework	Develop the conceptual, analytical and participatory components of the PAF in cooperation with the ADAM partners, apply

	the PAF in the adaptation and mitigation domains, disseminate ADAM results to European policy audience
P2: Policy and Governance	Map existing climate policies in the EU, assess effectiveness of policies, appraise the socio-economic and environmental impacts of policies, analyse governance dilemmas
P3: ADAM Case Studies	Apply the PAF to four portfolios of adaptation and mitigation policies, demonstrate the value of the PAF, develop policy options
P3a: Options for Post-2012	Develop a post 2012 portfolio in cooperation with stakeholders
P3b: International Development Assistance	Develop strategic options to mainstream climate mitigation and adaptation into development assistance
P3c: Electricity in the EU and Household Energy	Develop adaptation and mitigation options in the electricity sector
P3d: Regional Policies	Illustrate regional policy challenges in the Tisza River Basin, The Guadina Basin, and Inner Mongolia.
S: Scenarios	Use state-of-the-art climate models to produce four climate scenarios that will guide and contextualise the ADAM analysis

Each work package has been 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 have through the ADAM project sought to jointly appraise European climate policy options and thus offer useful decision support in a time when the future climate governance landscape is under negotiation. Although the potential users of the ADAM research results were not directly involved in the design of the project, policy relevance and usefulness emerge as central concepts in the project proposal. As confirmed by many work package leaders (personal communication with Edenhofer 2007, Haxeltine 2008, Eskeland 2007, Werners 2007), it is central that the ADAM policy appraisals feed into EU climate policy development and inform the ongoing UN post-2012 talks. While the project proposal identifies interaction with appropriate representatives of the European policy community as a central way of securing the relevance and use of the ADAM findings (Hulme 2004, p. 11), the project has explored a variety of arenas and modes for such interaction. In the following section, we offer an overview of the ADAM efforts to engage with stakeholders.

Democratic accountability through stakeholder engagement

According to the ADAM project coordinator (personal communication with Hulme 2009), ADAM was designed to facilitate a co-production process between the involved researchers and the EU climate policy community. By working closely with stakeholders, the research team set out to initiate a process of social learning that would adjust the ADAM research portfolio to new insights, ideas and discoveries. This mode of stakeholder interaction underpinned the project's Policy Appraisal Framework (PAF). In contrast to traditional Integrated Assessment Modelling (IAM) that typically combines scientific and socio-economic variables when assessing policy options for climate change, the PAF set out to include a broader set of variables in the appraisal of EU climate policy. Stakeholder participation and deliberation represents one such variable that was expected to enhance the reflective capacity of the research process and thus facilitate social learning (Haxeltine et al. 2007). By including the insights and perspectives of various stakeholder groups in each stage of the appraisal process, the PAF set out to provide more "socially robust" options for EU climate policy (Haxeltine et al. 2007, p. 35).

These elements of the PAF tap into the ideal co-production process as described by Lemos and Morehouse (2005). In order to produce knowledge that is perceived as usable and legitimate by affected actors, they suggest that the research process has to involve stakeholders in the problem definition, the formulation of research questions, the selection of methods, the analysis and dissemination of research results. This iterative interaction between knowledge producers and users is expected to build trust and re-shape both groups' perceptions, behaviour and agendas (Lemos and Morehouse 2005, p. 61). Moreover, when incorporating stakeholders as full partners in the assessment process, the scientific research is likely to be attuned to real-world problem solving and thus better reflect knowledge users' needs; i.e. to be useful. However, Lemos and Morehouse acknowledge that effective co-production is a time-consuming and resource intensive task that requires a high degree of commitment and flexibility by all involved actors. It may also stand in conflict with traditional academic career development and disciplinary advancement. And indeed, although the ADAM project proposal highlights the development of a novel Policy Appraisal Framework as a core project objective and deliverable, the PAF ran into difficulties.

One year into the project, two independent reviewers were asked by the EU Commission 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 and Böhringer 2007). Developed as a generic tool for climate policy appraisals in a rather top-down fashion, the PAF had run into critique and resistance among the researchers in the other project work packages. As a consequence, the far-reaching co-production process envisioned by the PAF was not initiated. In some work-packages (e.g. P3d) stakeholders were indeed closely involved in the research process. However, as noted by the reviewers (Verbruggen and Böhringer 2007), 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 co-production ideal underpinned the development of the PAF, 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 response to the reviewers' 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 change 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 between ADAM researchers and Europe's climate policy community. In parallel to the CEPS seminars, the ADAM steering group also highlighted three ADAM side-events at the thirteenth conference of the parties (COP 13) to the United Nations Framework Convention on Climate Change (UNFCCC) in Bali in December 2007, as an important meeting place for ADAM researchers and non-academic experts and opinion leaders (ADAM 2007). Moreover, the various work packages were also 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.

However, in contrast to the PAF, these other means of stakeholder engagement were not organised according to the co-production ideal. Rather than following the iterative process proposed by Lemos and Morehouse (2005), the CEPS seminars and the COP side events are in the project proposal described as a part of the ADAM project's dissemination strategy and therefore follow a more linear logic where the results of ADAM research are presented to stakeholders upon completion. Thus, the the linear approach to stakeholder engagement ran contrary to the original philosophy embodied in the PAF and thus raises questions about how well ADAM was able to secure the project's usefulness and legitimacy. In the following section we discuss how the ADAM response to the reviewers' critique played out in practice. Our aim is not to provide a complete picture of the ADAM project's stakeholder engagement practices. Drawing upon two examples from a diverse and complex engagement process, we instead seek to highlight a number of critical questions arising from these exercises that have bearing the broader scholarly efforts to link science to democratic politics.

Science speaking truth to power or vice versa?

In late January 2008 the ADAM work package P2 (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 (personal communication Hauge 2008). At this point in time the P2 group 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 research team hoped get input and ideas on their work from their main stakeholder groups, and hereby prepare ground for their continued research (personal communication Hauge 2008). 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 the research community. 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 debate between DG Research and DG Environment over the management of the ADAM project's research agenda (personal communication Haug 2008). 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 great interest in the ADAM research agenda. Two days prior to the P2 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 disappointment within the DG Environment that the P2 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 (personal communication Hauge 2008, Berkhout 2008). However, since the DG Environment had no direct influence over the ADAM research agenda, they could not compel the P2 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 the P2 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. At a different stakeholder workshop later the same year, the scientific coordinator of P2 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" (personal communication Berkhout 2008).

Moreover, the P2 coordinator pointed at the limited number of decision makers responsible for climate policy in the European Union. 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 P2 group 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 research team failed to create meaningful interaction, they disengaged and adopted a more traditional research design and dissemination strategy (personal communication Berkhout 2008). This experience could be interpreted as a failure on the part of the research team to engage their stakeholders in an early stage of the research process. 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 different institutional circumstances and time frames under which science and policy operate.

As noted by one P2 researcher (personal communication Hauge 2008b), there seems to be a certain degree of stakeholder fatigue in the European climate policy community. To find policy actors willing to engage in a time consuming and innovative co-production process is therefore a challenging task for any research project. To engage on terms defined by the policy community may not be an attractive nor feasible alternative for the involved scientists. In order to be useful in an ongoing policy process, advisory scientists need direct inroads to or experience of the policy making sphere that few academic scientists have. If scientists merely respond to the knowledge demands articulated in this sphere, they may indeed be perceived as useful. However, as noted by Nowotny (2003), such engagement may require that the scientific experts transgress their academic expertise and provide policy advice that put their actual or perceived scientific integrity at risk, as political judgments may pre-emptively

favour certain research results over others. Hence, although usable knowledge has been advanced as a major criterion for assessing the democratic accountability of science, this particular ADAM experience raises important questions about who gets to define what usable knowledge is and within which time frames such usability should be assessed.

Supporting or in support of European climate policy?

Social usability as a criterion of democratic accountability also raises questions about how and for what purpose research results are used in the policy process. The ADAM project's ambition to support European climate policy cuts to the heart of this question. As spelled out in the project proposal (Hulme 2004), European climate policy is facing considerable challenges in the post-2012 era. While securing long-term climate protection goals that are integrated across multiple sectors, EU climate policies also have to resonate with geo-political discourses, secure economic benefits and be acceptable to the European citizenry. In order to meet these challenges, scientific expertise is needed to identify, illuminate and appraise the possible policy options (Hulme 2004, p. 4). Hence, in the project proposal the ADAM project team identified a role for itself at "the interface between research, negotiation and implementation". However, to give scientific support to European climate policy development without being pulled into the politics of the climate negotiation and implementation process proved to be a difficult balancing act for the ADAM project. One illustrative example is the controversy over the EU 2 degree temperature target.

Since the mid 1990s when the Kyoto Protocol to the UNFCCC was negotiated, the EU has advocated and defended a 2 degree temperature target in the multilateral 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, one

central objective of ADAM has been to assess the mitigation and adaptation policies necessary to reach this ambitious EU target, and to identify their associated costs and effectiveness. The principle time horizon for this policy appraisal exercise has been from present time to year 2025, and for more innovative long-term policy options to year 2100.

To assess and develop portfolios of climate policy options for Europe is, however, not the same as to give support to existing policies or proposals. Nevertheless, in December 2007 the ADAM research team received signals from DG Environment that they should be careful with how their research results were interpreted. During COP 13 in Bali, 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 initial ADAM policy appraisals challenged the idea that the current portfolio of EU climate policies would be enough to reach the 2 degree target, the project was pulled right into the politics of the post-2012 negotiations (personal communication Hulme 2009). 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 made it clear that the ADAM project should respond to the DG Environment's wish to receive scientific support for the 2 degree target (personal communication Hulme 2009).

Hence, rather than pursuing the original project plan, the research agenda of the ADAM work packages on mitigation and scenarios was changed 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 intricate interplay between the EU Commission and ADAM only affected some project participants, it does raise questions about the political use (and usability) of scientific research results. Following the ideal co-production process as described by Lemos and Morehouse (2005), an adjustment of the research agenda to the knowledge needs of strategic user groups (in this case EU policy makers) is central for the usability and democratic accountability of science. However, while these attempts to adjust scientific knowledge production into a collaborative exercise indeed may attune science to real-world problem-solving, they do also open up for a strategic (mis)use of science for political purposes. As noted by the ADAM project coordinator (personal communication Hulme 2009), the ADAM project aimed for an open-ended co-production process with the European climate policy community that would stimulate mutual learning. However, over time the project ended up in a mode of engagement where "science is there to serve political goals." Although the 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 an independent critique. Hence, rather than emerging as an honest broker of alternative polcies, there is a risk that ADAM is perceived as a policy advocate in support of the political agenda of the DG Environment (personal communication Hulme 2009).

Discussion and conclusions

In this paper we have drawn upon the stakeholder interaction practices in the European ADAM project to discuss the social accountability of science. Naturally the examples of engagement examined in this brief case study only offer a partial picture of the diverse and rich ADAM experience. Resting upon a selected set of semi-structured interviews and participant observations, our empirical account should therefore not be seen as an attempt to paint a comprehensive picture of how the ADAM research team has interacted with its stakeholders. Nevertheless, the experiences discussed here have bearing on the broader scholarly debate that has set out to replace "the culture of scientific autonomy with a culture of accountability" (Nowotny et al. 2002, p. 119). Central to this debate is the normative presumption that the quality and usability of scientific knowledge no longer can be

determined by scientific peers alone. Those actors in society that are paying the bill for research, and those to whom research efforts set out to be useful, should also have a say in scientific agenda-setting and quality assessment (Jacob 2006, p. 28). Although public engagement in science currently is advocated as the primary means by which science should be held responsible to its public constituencies, our study suggests that such engagement is fraught by many real-world constraints and incentives. Below we highlight three critical questions that arise from our analysis of the ADAM project.

Firstly, our study raises the question how to best involve knowledge users in the research process while, at the same time, securing academic career-development for the involved scientists. To include knowledge users as "full partners" in the research process (Lemos and Morehouse 2005, p. 61) does indeed imply a new mode of knowledge production that still is rare within the academic community. In order to successfully engage in such co-production, Lemos and Morehouse (2005, p. 64) suggest that scientists have to be ready to participate in a range of activities not commonly part of the academic endeavour, develop long-term interactions with constituents, and to sustain bi-directional flows of information between project members and stakeholders. In the ADAM case, the work packages that came the closest to this ideal were those where good contacts with local decision-makers already were in place when the project started. In these cases (e.g. the Tizsa case study in P3d), user groups were closely involved in the design and formulation of research questions (Flachner 2007). However, in most other ADAM work packages the stakeholders entered the research process at a later stage. This led to different engagement dynamics that complicated the sense of mutual trust and learning central to the co-production idiom.

It is important to remember though that far from all ADAM researchers expressed a commitment to co-production. One of several explanations to the failure of the PAF was the lack of support within the ADAM research team for the iterative, time-consuming and poorly defined stakeholder engagement procedures built into the framework. Many researchers in ADAM (including those outside the PAF) found the complicated PAF process too resource intensive (personal communication Biermann 2009). The academic rewards for the "extracurricular" engagement activities central to the PAF were also perceived as unclear and unhelpful to disciplinary advancement. Since many senior ADAM researchers participated in the project on the basis of their disciplinary expertise, and the early career participants had to secure their academic career development, the project proposal's co-production idiom turned

out to be less pronounced in practice. Nonetheless, most ADAM work packages were guided by the ambition to provide useful policy advice. To that end, the various research teams embarked on more ambitious stakeholder exercises than what normally is the case in traditional academic research. The terms under which these exercises have taken place do, however, raise a second question of more general kind; namely which user groups that should assess the accountability of science?

As noted by Jasanoff (2003), a new culture of scientific accountability does not only draw attention to a responsible agent to whom public authority has been delegated. The principal who delegates such responsibility and therefore can hold agents to account, also requires further scrutiny. In the science and society literature, the principal that has received most attention are citizens or publics. Justifying public engagement in science on democratic grounds, a number of scholars have envisioned a closer involvement of reflective and knowledgeable citizens in the governance of science (Felt and Wynne 2007, Jasanoff 2003). Other authors have instead talked about knowledge users or stakeholders as the main principals (e.g. Sarewitz and Pielke 2007). From this perspective, actors in society that have a stake in, or are expected to use, scientific research results are the ones that should assess the extent to which research agendas meet desired societal ends. The ADAM project taps into the latter interpretation of scientific accountability. Designed to give support to the European climate policy, the project identified the European climate policy community as its main stakeholder group. The DG Research and DG Environment played a particularly pronounced role in most of the ADAM work packages.

However, to ask civil servants and policy makers in the European Commission to assess the accountability of a research project such as ADAM can result in a very narrow interpretation of useful research, one shaped strongly by the immediate political context of the policy makers. As indicated by the two examples of engagement practices discussed above, members of the climate change unit in the DG Environment interpreted the ADAM project's aim to support European climate policy as a way to get scientific input to their daily work and backup for the pre-existing European position in the UN climate negotiations. One ADAM researcher suggests that the ADAM project became hijacked by the DG Environment and their call for short-term policy advice (personal communication with van Asselt 2009). Another interpretation is that the ADAM project was hijacked by a too ambitious project proposal. By defining the European climate policy community as their main stakeholder

group, and promising to deliver useful support to European climate policy, the ADAM research team may have built a trap for themselves that compelled them to respond to the pre-determined knowledge needs of their main constituents. This restricted interpretation of scientific accountability gave the project participants very limited room to legitimately pursue long-term research agendas that challenged the direct interests and needs of the European Commission.

This finding leads us to the third and final question arising from the ADAM experience. If the accountability of science hinges on the knowledge needs of a limited number of user groups with limited interest or ability to adjust their political or policy perspectives, what room is left for critical reflection and intellectual innovation? As noted by Jacob (2006, p 25), there is a risk that we reduce science to consultancy if we make the eligibility of funding dependent on stakeholder/user groups' testimony that the proposed research will be useful to them. "Users may for example because of their pressing needs push the research community towards more radical lines of research because they may promise greater potential for a solution. Alternatively, 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" (Jacob 2006, p. 30). In our interviews, several ADAM researchers returned to the importance of striking a balance between scientifically motivated research and policy advice. As one participant put it; "ADAM is not designed to respond to every whim of the DG Environment. This does not mean that we are not doing a good job in responding to policy demands" (personal communication with Haxeltine 2008). A long-term project such as ADAM is likely to deliver long-term policy recommendations, not day-to-day advice (personal communication with van Asselt 2009). These reflections draw attention to the time frames under which the usability of science is assessed. When does it make sense to ask if scientific research efforts have managed to meet desired societal ends? The answer to this question lies in a fuller understanding of the context of engagement between experts and decision makers and appropriately structuring that relationship (Pielke, 2007).

All these questions bring us back to scholarly efforts to establish a new social contract for science and hereby link the academic endeavour to democratic politics. In this paper we have found that this scholarly debate involves numerous standards against which the accountability of science should be assessed. To date usability emerges as the most operative of these standards. By asking knowledge users if scientific research results are useful to them, it is

possible to determine if science lives up to or breaches its new democratic responsibility. However, a culture of accountability organised around the social usability of science involves a number of shortcomings. Drawing upon the experiences of the European ADAM project, we have in this paper highlighted some of these shortcomings. By asking how, by whom and when the usability of science is assessed, we have found an asymmetrical and uneasy relationship between the ADAM knowledge producers and users. In particular, the ADAM experiencey prompts us to carefully reflect upon the consequences of various accountability standards. In order to make the scientific journey from a culture of autonomy to a culture of accountability intellectually compelling and rewarding, we conclude that scholars of science and society need to offer more specific answers to the how, whom and when of engagement.

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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