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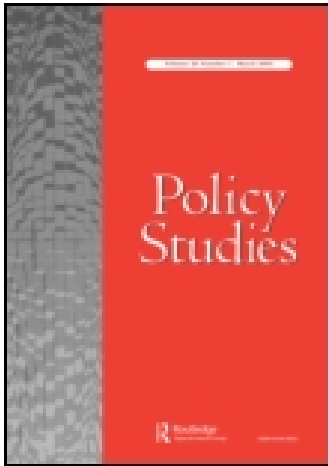
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What do policy-makers do with scientific uncertainty? The incremental character of Swedish climate change policy-making

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RESEARCH ARTICLE

What do policy-makers do with scientific uncertainty? The incremental character of Swedish climate change policy-making

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This article explores how policy-makers are managing scientific uncertainty in policy-making. This is done through a case study of the Swedish climate change policy process from 1975 to 2007, based on interviews and an extensive review of official publications and documents. The study shows that scientific uncertainty played a very marginal role in the development of Swedish climate politics. When faced with scientific uncertainty, policy-makers came to rely more on knowledge of what was politically possible to do, than on what was desirable from a scientific perspective. Thereby, policy-making became incremental in character. The article argues that in order to understand the dynamics involved, we need to pay attention to how scientific knowledge and uncertainty are translated from a scientific context into a political one. These framings, done by knowledge brokers, are crucial for the use of scientific knowledge in politics. Scientific uncertainty negatively impacts scientists' willingness to act as knowledge brokers and thereby the possibility of policy-makers to use knowledge. The article argues that despite the lessons from previous research, there seems to be a need for empirically grounded studies that highlight the limits of the rational paradigm captured in, for example, evidence-based decision-making.

Keywords: scientific uncertainty; policy-making; knowledge; incrementalism; climate change; Sweden

Introduction

Uncertainty is problematic from a rational perspective. It is not uncommon to find a belief in rational policy-making among the general public, academics as well as policy-makers, as visible in the concept of evidence-based decision-making (cf. Botterill and Hindmoor 2012). However, we have long known that a fully rational decision-making is no more than an ideal, at best. Scholars developed concepts like bounded rationality (Simon 1957) and incrementalism (Lindblom 1959) more than 50 years ago. Despite this, rational policy-making still seems to be the ideal in many contexts (cf. Stone 2002; Tenbenschel 2004; Heazle 2010; Lemos and Rood 2010; Meyer 2011). From a rational point of view, scientific uncertainty is seen as deeply problematic for policy-makers. It disables informed and, thereby, rational decisions. In academia, increasingly more focus has been placed on the role of scientific uncertainty in policy-making over the last years. Articles on the topic abound, although few in political science. Concern is given first, to the need to decrease uncertainty in order to enable policy-making (e.g. Shukla et al. 2009),

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second, to the need to communicate uncertainty to enable policy-making (e.g. Ascher 2004; Kandlikar, Risbey, and Dessai 2005; Smith and Stern 2011), and third, to policy strategies to cope with uncertainty (e.g. Mearns 2010; Smith 2011; Funke and Paetz 2011). All these three themes take rational decision-making, implicitly or explicitly, as point of departure – more and better knowledge is needed in order for policy-makers to make good decisions, and if that is impossible, strategies that are bounded rational need to be envisioned. Few studies look at how policy-makers actually go about scientific uncertainty – what do they do with it? Based on the rational logic, some argue that policy-makers are unwilling to make decisions in the face of uncertainty (e.g. Bradshaw and Borchers 2000). Others, from a more incremental point of view, argue that scientific knowledge or uncertainty is used to legitimate political decisions, of either acting or not acting (Ezrahi 1980; Jamieson 1996; Hisschemöller et al. 2001; Heazle 2010). This study, of the Swedish climate change policy process from 1975 to 2007, shows that scientific uncertainty seems to be less important in policy-making than has been assumed. For policy-makers, the problem seems to be that scientific knowledge was not framed in a politically accessible way, and thereby became unhelpful as policy advice. That knowledge was uncertain was less of a problem. When policy-makers were unable to find or use scientific knowledge for their decisions, they tended to rely more on political knowledge of what works and what can politically be agreed on.¹ The case shows that policy-making in the face of scientific uncertainty became incremental as there was no available advice from scientists. The article argues that we need to study the interaction between scientists and policy-makers to understand the role of uncertainty in the policy process.

Scientific uncertainty

The result should not be surprising from an incremental perspective. It is only when we assume a rational stance that the presence of scientific uncertainty becomes an obstacle to policy-making. Uncertainty is a fundamental part of politics. Decision-making under certainty is possible only in the examples of textbooks – real life decision-making is always more or less uncertain. Uncertainty in policy-making does not always involve scientific uncertainty though. In many cases, science has nothing to do with decisions, but in some cases, it does. In this study, scientific uncertainty is seen as both lack of knowledge and diverging scientific results. From a policy-maker's perspective, both are uncertainties about scientific knowledge. Climate change is a good example of a policy issue with both lack of scientific knowledge and diverging scientific results. Uncertainties involve the extent to which human actions influence the climate system; the sensitivity of the climate system to increased levels of greenhouse gases; and the effects that climate change can have on natural and societal systems and the speed of these processes. The case study looks into what Swedish policy-makers have done with that uncertainty.

Framing knowledge and uncertainty in the policy process

To be important in the policy process, scientific knowledge (and uncertainty) needs to be translated into political knowledge. This is done by framing (cf. Schön and Rein 1994; Jasanoff and Wynne 1998). To frame knowledge, and uncertainty, means

to think about it in a particular way. This implies that some aspects of an issue are emphasised rather than others. In translating knowledge from a scientific to a political context, a situation is made understandable as a political problem. The statement that the climate is warming is uninteresting from a political perspective until it is set in relation to what consequences it might have and what we can do about it. A political problem, therefore, entails an understanding of the situation, but also a possibility to do something about the situation (cf. Wildavsky 1987; Stone 1989; Rochefort and Cobb 1994).

The translation of knowledge from science to politics – from situation to problem – is performed by knowledge brokers. According to Litfin (1994, 4), knowledge brokers are ‘...intermediaries between the original researchers, or the producers of knowledge, and the policymakers who consume that knowledge’. In that capacity, they wield considerable power over how issues are understood as political problems. Knowledge brokers, as seen here, frame scientific issues in ways that policy-makers can understand. This means that they connect scientific facts with political values. In the words of Schön and Rein (1994, 26): ‘Through the process of naming and framing, the stories make the “normative leap” from data to recommendations, from fact to values, from “is” to “ought”’. This means that the articulation of facts will make them in some sense subjective, as they are connected to some ways of thinking rather than others.

One important aspect of the concept of knowledge brokers is that it highlights what these actors do, rather than what they are, as compared to, for example, the perspectives of epistemic communities (Haas 1992) and of advocacy coalition frameworks (Sabatier and Jenkins-Smiths 1999), which both emphasise the group and how it is bound together. This study departs from a view on the policy process that does not see group action as a necessary precondition to influence. The important prerequisite for influence is rather being at the right place at the right time, with usable framings (cf. Kingdon 1984). Surely, this will in most instances be easier for a group. For knowledge brokers, the capacity and willingness to frame scientific knowledge in a politically accessible language are crucial. What is important is not only the work that actors do, but it is the frames they generate that make certain understandings of political problems and solutions possible. How knowledge brokers frame what we know, what we do not know, and when we will know it, is what possibly could influence the policy process.

The Swedish climate change policy process

The study covers the Swedish climate change policy process during the period from 1975 to 2007. The period extends from the first framing of climate change as a political issue in the Swedish context to the time when climate change became seen as one of the most important political issues. The material consists of 39 interviews with a broad range of politicians, political appointees, civil servants and scientists. The interviews were conducted with the aim of gaining access to the respondents’ views on scientific uncertainty and how they have managed it. In order to get such information, the questions asked concerned how the respondents worked with climate change generally. Thereby, the often unconscious ways of dealing with scientific uncertainty could be revealed. All interviews are not cited in this article, but are part of the broader material on which the conclusions are drawn (see further

Knaggård 2009). The material further consists of a broad range of official political documents, like committee work, government bills, parliamentary debates and decisions and of newspaper material (mostly debate articles). Reports from a broader scientific community, addressed at policy-makers, have also been studied, including the Intergovernmental Panel on Climate Change (IPCC) and reports from the time before the organisation was formed.

Throughout the entire period studied, scientific uncertainty in framings of climate change has played only a marginal role in the Swedish climate change policy process. Changes in the degree of uncertainty cannot be used to understand the growing importance of climate change as a political issue, from the time it was placed on the political agenda in 1988 until it began to be framed as one of the most important political issues in 2005, as would be assumed in a rational perspective. In some cases it has been an obstacle for political action, but these occasions are rare. This result is supported by a study by Michael Heazle (2010) on how the governments in the USA and the UK managed uncertainty connected to the Iraqi war and climate change. Heazle argues that the management of uncertainty is dependent on how an issue can be connected to existing political values and interests.

In the following, I will, first, use examples from the Swedish case to show the limited effect of uncertainty on the evolution of Swedish climate politics; second, develop a theoretical understanding of how policy-makers deal with uncertainty; and third, discuss the major conclusions of the study.

The evolution of Swedish climate politics – uncertainty at the margin

The studied period is divided into three phases. The first ranged from 1975 to 1987 in which climate change was not on the political agenda, but scientists and other actors worked as knowledge brokers to frame it as a political issue. The second phase ranged from 1988 to 2000 in which climate change was established on the political agenda. In the third phase, from 2001 to 2007, the prominence of climate change as a political issue increased until it was framed as one of the most important political issues.

One of the first occasions that climate change was brought to the attention of Swedish policy-makers was in a report from 1975. It was written by the Swedish climate scientist Bert Bolin, who later became the first chairman of the IPCC. He stated that uncertainties were large, but that the increase of emissions of carbon dioxides was worrying and that this warranted political action (Bolin 1975). The report was cited in a following government bill on energy, where climate change was framed as a political problem for a distant future (Government bill 1975: 30, Interview 12). With few exceptions, policy-makers did not pay attention to the issue at this time, except as another reason to decrease dependence on oil and coal, in the aftermath of the first oil crisis. After the Swedish referendum in 1980 on nuclear power, the parliament decided on its phase-out by 2010 (Parliamentary resolution 1979/80:410). It became problematic to talk about climate change, as oil and coal were the main energy sources that could replace nuclear power. Climate change as a political problem therefore faded from the energy debate.

Despite the problems in finding substitutes for nuclear power and continuous uncertainties about climate change, climate was framed as a political issue by the Swedish parliament in the late 1980s. The initiation came in 1988 from the

Conservative party, then in opposition (Motion 1987/88:Jo25). It suggested a national target for emissions of carbon dioxide. It is clear that the Conservative party used climate change to try to reignite the debate about nuclear power. They wanted to postpone the phase-out as long as possible, and realised that a climate target would make the phase-out more difficult (Interview 11, 14, 18, Parliamentary record 1987/88:135, statement 1). All parties but the Social Democrats voted for the target. The new-found support for climate policies cannot be understood by decreased uncertainties. The scientific knowledge on climate change at that time was based on knowledge of physical processes and models. No actual change had, at that time, been observed (Interview 1). Scientific uncertainties were still large.

What was more important than scientific uncertainties was that more policy-makers had come in contact with the issue of climate change. In the 1970s and large parts of the 1980s, climate change was seen as a political issue only by a group of climate scientists working in different countries and by a few civil servants, who came to function as knowledge brokers. They met at a number of conferences and meetings during the 1980s and began to call for political action (e.g. WMO 1986, 1989, cf. Pomerance 1989). By 1987, when Our Common Future (WCED 1987), the so-called Brundtland report, was published, this changed. From being an issue for a smaller circle of people, climate change became an issue that was discussed in the United Nations. In the Swedish case, the influence of the Brundtland report on the political debate is evident. The climate target from 1988 was for example motivated with reference to the report (Motion 1987/88:Jo25, Parliamentary record 1987/88:134). In Our Common Future, the climate change issue was explicitly framed as highly uncertain, yet severe enough to warrant political action (WCED 1987, 177):

The key question is: How much certainty should governments require before agreeing to take action? If they wait until significant climate change is demonstrated, it may be too late for any countermeasures to be effective against the inertia by then stored in this massive global system.

Later developments of Swedish climate change politics also seem to have more to do with spread of knowledge than with its quality. During the 1990s, a remarkable mapping and growth of scientific knowledge on climate change occurred. The node of this work was the IPCC, which was created in 1989 (see e.g. Agrawala 1998; Bolin 2007). This work resulted in an assessment of knowledge, but also of uncertainties. By the middle of the decade, the IPCC could report on actual observations of climate change (IPCC 1995). Thereby, the knowledge was no longer only theoretical. Climate change was now framed, not as something happening in a distant future, but as something already happening and thereby as something less uncertain.

The increased knowledge and the IPCC's new frame of climate change did little to change the way Swedish policy-makers perceived the issue. It was seen as one of many important environmental problems, as was the case already in 1988. The major change in attitude came first during 2001. Two developments were important for this change. The first one was the work by a parliamentary committee, called the Climate Committee. It started its work in 1998 to prepare a ratification of the Kyoto Protocol, and finished in 2000 (SOU 2000:23). The committee work resulted in a government bill in 2001 with suggestions for a new climate policy (Government bill 2001/02:55). The committee functioned as knowledge broker, which spread

knowledge about climate change and the work by the IPCC to representatives of all parties within the parliament. As one of the Social Democratic representatives explained, the work contributed to a massive increase of knowledge about climate change among the members of the committee ([Interview 3](#)). They could then channel this knowledge to other members of their parties.

The second development that was crucial for the new climate frame was the Swedish EU chairmanship in the first half of 2001. At that time, the international climate change negotiations were at a critical stage (cf. Dessai and Schipper [2003](#)). The efforts to finalise the regulation established in the Kyoto Protocol from 1997 ended in the U.S. declaring its unwillingness to continue the discussions. The Kyoto Protocol seemed to be doomed. However, the Swedish Minister for the Environment, Kjell Larsson, together with the then Swedish EU Commissioner for the Environment, Margot Wallström, worked to secure support for continuing the process. Within this period, the Swedish government framed climate change as one of the most important environmental issues (Parliamentary record [2000/01:47](#), statement 112). Even after the Swedish EU chairmanship had ended by midyear 2001, the new frame endured. In his governmental declaration in the autumn 2001, the Swedish Prime Minister Göran Persson stated that climate politics was given the highest priority, internationally as well as nationally (Parliamentary record [2001/02:2](#), statement 3).

The two developments contributed to a spread of knowledge about climate change in wider circles. The Climate Committee spread knowledge among members of parliament, whereas the Swedish EU chairmanship spread knowledge within the government. The governmental declaration from 2001 was the first time that the Prime Minister acknowledged climate change as a critical political issue (cf. [Interview 17](#)). This had little to do with reduction of scientific uncertainties.

Beginning in 2005, climate change was increasingly framed as one of the most important political issues. One reason for this was the winter storm in early 2005, called Gudrun, which caused large financial losses in the forestry industry in the south of Sweden. In the newspapers, as well as in the political debate, commentators had begun to connect extreme weather to climate change already earlier (e.g. Parliamentary record [2000/01:10](#), statement 1, 2, 6, Boström [2004](#), debate article), but the winter storm of 2005 really increased the political focus on climate change ([Interview 9](#), cf. Uggla [2009](#)). Even though a particular storm, like Gudrun, scientifically could not be set in connection with climate change, it seemed to have illustrated the possible effects of such a change to people. The Swedish Environmental Protection Agency had already in 2001 started to discuss society's vulnerability to climate change ([Interview 1](#), 4) and the Minister for the Environment, at the time, started to pay attention to the issue in 2003 ([Interview 7](#), Uggla [2009](#)). The storm made knowledge spread outside of the specialised ministry and agencies. Contributing to the new frame was also a commission that investigated the vulnerability of the Swedish society to climate change, which was set up some months after the winter storm, called the Commission on Climate and Vulnerability. It was not a parliamentary commission, but worked closely with public authorities on national, regional and local level as well as with business, organisations, and universities ([Interview 4](#)). Prior to that, most municipalities had not reflected on the possible effects of climate change. Through the committee work, knowledge about society's vulnerability to effects of climate change was spread to these and other actors.

In conclusion, the Swedish case does not support the often implicit assumption that a decrease of scientific uncertainty will make policy-making more likely.

How policy-makers go about scientific uncertainty

The fact that the general evolution of Swedish climate change politics seems unaffected by decreases in scientific uncertainty does not say anything about what policy-makers actually do with uncertainty. The way policy-makers managed scientific uncertainty in the Swedish case can be divided into four subtypes. These can be understood along two dimensions. The first dimension is if policy-makers focus on scientific uncertainty or on what we actually know. Both these categories are heavily dependent on the framings that knowledge brokers do. The second dimension is if policy-makers focus on science and what scientists say, or on politics and what is deemed as possible and acceptable from a political perspective. These two dimensions – a focus on uncertainty/knowledge and on science/politics – capture four distinct types of how scientific uncertainty can be managed. The four strategies are ‘decreased uncertainty’; ‘trust scientists’; ‘precautionary actions’ and ‘possible actions’, see (Figure 1). These four will be explored below with examples from the Swedish case.

Focus on uncertainty and science

In many ways, a focus on uncertainty coupled with a focus on science can be seen as the ‘rational’ strategy. Uncertainties are perceived to be too large for decision-making. Scientists then need to decrease uncertainty, to later enable better informed decisions. However, this approach can also be a way to depoliticize an issue. By conditioning political action on more scientific knowledge, responsibility for the issue can be transferred from policy-makers onto scientists, and political action can thereby be avoided. By itself, it is impossible to know if calls for further scientific studies due to uncertainties are made in a rational vein or in order to avoid political action. From existing research, there is reason to believe that both rationales would be fairly common (e.g. Ginsburg and Gorostiaga 2001). In the studied case, there are few examples of calls for further knowledge.

One exception is when the Social Democrats in the late 1980s voted against the climate target in the parliament. They argued that further internationally

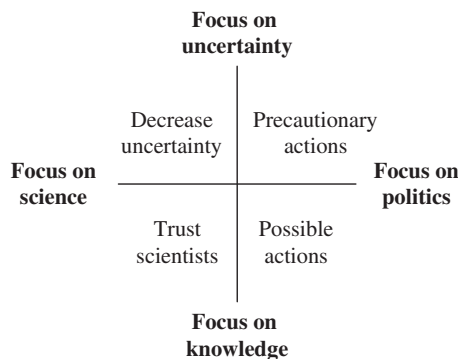


Figure 1. Four approaches to manage scientific uncertainty.

coordinated research efforts were needed to enable a sound political management of climate change (Government bill 1987/88:85). The Minister for Energy and the Environment was at that time focused on the international efforts to deal with environmental problems. She argued, both in speeches at the time and in the interview, that she believed the proper response to be global and that the scientific uncertainties made a national climate target premature (Parliamentary record 1987/88:134, statement 16, Dahl 1990, Interview 11). This could be interpreted as the Social Democrats invoked a rational strategy to take a better informed decision at a later point. There was a second reason behind the Social Democrats' decision, which comes out clearly in the parliamentary debate. The reason was that a national climate target would endanger the phase-out of nuclear power. The argument in the parliamentary debate following the target decision was that emissions of carbon dioxide would be reduced in a longer time perspective, but that the phase-out of nuclear power was prioritised in the short term (Parliamentary record 1987/88:134, statement 11). This argument points in the direction of an effort to depoliticize climate change, by calling for further research. The most likely interpretation is that the Social Democrats were internally divided on the issue.

A second example of a call for further research concerned the vulnerability of society and the need to adapt to climate change after the winter storm in 2005. Knowledge about these issues was framed as too limited for political action in a government bill from 2006 (Government bill 2005/06:172). Their call for research has to be interpreted as based on the rational strategy. Adaptation was very much an issue on the political agenda, but translated knowledge was scarce. Even though the IPCC already in 1995 had argued that adaptation, despite large uncertainties, was possible without further research (IPCC 1995), policymakers, for different reasons, felt they did not know enough to make good decisions (Interview 5, 7, 9).

The conclusion from the study is that this approach to manage scientific uncertainty was fairly unusual and adopted less often than previous research would indicate (e.g. Boehmer-Christiansen 1994; Heazle 2010). We therefore have to consider that this could be a specific trait in Swedish policy-making.

Focus on knowledge and science

Another approach to manage scientific uncertainty is to focus, instead of on uncertainty, on the existing knowledge in combination with a focus on science. In the climate case, an example is to focus on the scientific knowledge about sea level rise, and not on the uncertainty connected with the size of that rise. This approach to trust scientists can be used for different reasons. It can be practical to legitimise a decision with scientific research, as it makes the decision harder to question. If the decision, in hindsight, turns out to be wrong, policy-makers can blame scientists for the failure. Another reason to focus on scientific knowledge, when faced with uncertainty, is that it is possible to base decisions on the already existing knowledge.

The most interesting example of this strategy pertains to the two degrees target, which has long been advocated by the EU (Council meeting 1996), but only recently included in international agreements (Copenhagen Accord 2009). The background to the two degrees target is the goal of the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC was negotiated during 1991 and opened for signature the following year. Its objective is formulated as 'stabilization of

greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system' (UNFCCC 1992, art. 2). The interesting part here is the formulation dangerous anthropogenic interference. The meaning of this is not clear, which surely was a reason for the formulation. Over the years, scientific as well as political discussions have taken place on its interpretation. At a meeting in 1995, the issue was considered by the IPCC and it was decided that the organisation would not try to specify a dangerous level (Interview 4). The decision on a dangerous level was seen to be political, as it included judgments of what society was willing to accept. The IPCC therefore settled at describing possible effects of warming at certain levels (Moss 1995; Schnellhuber et al. 2006). They thus tried to frame the issue as political.

The problem for policy-makers, as expressed in interviews with Swedish policy-makers, was that it was impossible for people other than scientists to judge the possible long-term consequences of climate change for society, as uncertainties were seen as too large (Interview 5, 7). They claimed that they had to trust scientific judgments. Policy-makers in the Ministry of the Environment afterwards believed that the two degrees target was based on the IPCC report (Interview 5, 7). They thereby tried to justify the target by referring it to scientists. Although the IPCC did not take a stance on the issue, other scientists did. Already in 1990, the Stockholm Environment Institute (SEI) published a report arguing that a global warming above two degrees over preindustrial levels was too high a risk to take (Vellinga and Gleick 1990). The statement was cited by the Swedish Environmental Protection Agency two years later (SNV 1992), which in turn was cited in the Swedish climate government bill from 1993 (Government bill 1992/93:179). Later two Swedish scientists claimed that, given the uncertainties, a global warming of two degrees could work as a political target. With increasing knowledge, the target would need to be reassessed (Azar and Rodhe 1997). In the interview, one of them said that the reason to suggest two degrees was that it was a 'good round number' (Interview 6). In the European context, there were also others who made such suggestions (see Tol 2007). What these scientists did was to focus on the existing knowledge and, based on that, suggest a specific target.

The scientists that actually made policy suggestions seem to have had a very large influence on the formulation of the two degrees target. An interesting aspect of the two degrees target is how both scientists and policy-makers have wished to exclude the issue from their respective responsibility, partly due to uncertainties. Scientists within the IPCC framed the issue as political and choose not to take a stance on a dangerous level. Policy-makers, at least the Swedish ones, framed the issue as scientific and decided to trust those few scientists that actually did take a stance on the issue.

The evidence from the case indicates that this is also a fairly uncommon approach to deal with scientific uncertainty. One reason for this could be that the uncertainty as such makes scientists more unwilling to act as knowledge brokers and translate the existing knowledge into politically relevant knowledge. Scientists are generally trained not to go beyond what they can actually prove. There are worries that, by translating knowledge especially if it is uncertain knowledge, you become too closely associated with politics and thereby lose your neutral scientific standing. This can be illustrated by the criticism against scientists acting as knowledge brokers. This is present in the Swedish case (e.g. Gerholm 1994; Karlén 1994) and in the American

context (see Colglazier 1991), as well as concerning the Stern review from 2007 (Nordhaus 2007). In the studied case, the idea about pure science (cf. Merton 1973) has definitely discouraged scientists from acting as knowledge brokers. If there are no knowledge brokers, there will be no scientists to trust and no translated knowledge to base political decisions on.

Focus on uncertainty and politics

A radically different approach to manage scientific uncertainties is to focus on uncertainties and politics. Compared to the previous approaches, policy-makers here acknowledge that science might not have the answer and that action needs to be taken anyway. Political action is justified despite uncertainties. This approach can be described as precautionary action. Precaution means that we should not wait for more knowledge, if we believe that an activity could have negative effects on humans and the environment. In many ways, it is the opposite of what the rational approach would imply. The precautionary principle has been criticised for this reason, as not being based on 'sound science' (cf. Stirling 2007). Another interpretation of precaution is that it gives policy-makers a possibility to claim ownership over an issue. It is a way to frame a scientifically impregnated issue as clearly political. There could be a number of different reasons for framing issues as political in this sense. One reason is that one believes that more scientific certainty in the issue is impossible or that the research needed will take a too long time. The critics of the precautionary principle also emphasise that a reason could be to accomplish other political ends, totally unconnected with the status of knowledge. One example is to blame the protection of domestic meat production on uncertainties about hormones in beef.

In the studied case, the belief in precautionary action was very strong in the late 1980s and beginning of the 1990s. Several of the interviewees responded that, at that time, action to a high degree was taken on the basis of the precautionary principle (Interview 11, 14, 15, 16). Some described policy-makers' feelings of not wanting to fail again, after earlier failures to act (Interviews 11, 15, cf. Harremoës et al. 2001). However, precautionary thinking did not lead the people at the ministry to include more action on climate change in the government bill from 1988. The ensuing motion from the Conservative party that suggested the climate target was also not grounded in precautionary thinking. It was rather a means to an end – a reopened debate on nuclear power. Both in the Swedish context and internationally, the precautionary principle was used to legitimise political action first in 1990 (Dahl 1990, cf. Cameron and Wade-Gery 1992). One reason for this could be that the knowledge base needed to be sufficiently developed for precaution to be a realistic legitimisation of political action. Policy-makers need to know what the uncertainties are to be able to decide about them. Therefore, it was only when the IPCC had almost finished its first assessment report in 1990 that policy-makers judged the knowledge to be certain enough for invoking precaution.

Even if several of the interviewees claimed that the precautionary principle was very important for decision-making around 1990, the material does not support that precaution was a major reason for the political decisions made. The adoption of the UNFCCC was an exception. However, this does not mean that precautionary thinking was not present at the time. Important in this regard is that precaution can be used to legitimise that an issue is brought up on the political agenda. It does not

give guidance as to what to do with that issue. The precautionary principle is thus important only in the phase of the policy process when actors try to frame an issue as political. The evidence from the case could be interpreted in this vein. It was a general feeling of obligation and urgency that made policy-makers, both in Sweden and internationally, discuss climate change from the start. As soon as climate change was accepted as a political issue, precautionary action had played out its role.

Focus on knowledge and politics

By far the most common approach to manage scientific uncertainty in the Swedish case was to focus on knowledge and politics. Instead of trusting scientists or acting precautionary, decisions were based on what actions were politically possible. This approach is less about legitimising decisions than about actually making decisions. When there is no scientific knowledge to base decisions on, policy-makers turn elsewhere – to what they know. Decisions can be based on their knowledge of policy instruments, knowledge about what actions are planned on national and local levels, and on what they know can be accepted in the parliament. It is thus the genuinely incremental approach to scientific uncertainty.

The approach is incremental both in the sense that the political aspects of decision-making are highlighted over the rational ones, and in that it leads to a focus on only small changes of the status quo. The major difference between the approach to focus on possible actions and the one to trust scientists is that the former is not based on what, from a scientific perspective, is desirable in a long-term perspective, as the latter is. The former approach is based on ‘what is politically feasible rather than desirable, and . . . possible rather than “maximal”’ (Howlett and Ramesh 2003, 170).

In several interviews, this approach was highlighted (Interview 4, 5, 8, 12) – decisions had to be made based on practical experience and subtle intuition, as one of the interviewees put it (Interview 8). Prominent examples are decisions on climate targets and on the 1991 tax on carbon dioxide (Interview 13). A good illustration is the decision on a Swedish emission target in 2001. The decision ratified the Kyoto Protocol from 1997 and the emission reduction targets that were suggested therein. In the UNFCCC from 1992, the main objective was formulated so as to avoid dangerous anthropogenic interference with the climate system. In the Kyoto Protocol, this type of long-term goal had been abandoned and was replaced by a short-term goal decided through political negotiations. Sweden negotiated within the EU collective, and the EU had been allowed to internally divide the emission reductions between their member countries, the so-called EU bubble. The Social Democratic government, in negotiations within the EU, agreed to set the Swedish target for greenhouse gases at an increase of 4% compared to the level in 1990 (Council Decision 2002/358/EC, Interview 2, 17, cf. Phylipsen et al. 1998; Kanie 2003). The parliamentary committee that investigated how the Kyoto targets could be reached suggested a decrease of 2%. The committee judged that target to be realistic, in terms of reachability (Interview 10, SOU 2000:23). In the preceding government bill, the target was lowered still. The new suggestion was to decrease emissions by 4% (Government bill 2001/02:55). This was the result of a political compromise between the Social Democratic party, the Left party and the Green party, where the latter opted for a much larger reduction. In the government bill, as

well as in interviews, it was emphasised that the new level was based on what was deemed possible to reach with existing and new policy instruments (Government bill 2001/02:55, [Interview 2](#), 5).

The example displays the inherently political aspects of policy-making. The emission target had nothing to do with the long-term objective of no dangerous interference. It was rather known that this could only be a very small first step. The fact that Sweden decided to go beyond what was decided in the EU negotiations can have a number of explanations. The important part here is that it shows how scientific uncertainty can be managed by focusing on what is possible in the short-term – something that is easier to know for policy-makers – than on a highly uncertain knowledge about a distant future. The example also demonstrates that when issues are framed in this way, they become easier to debate. The discussion within the EU, as well as in Sweden, to a high degree concerned political feasibility. By framing the issue in political terms and focusing on what is known, Swedish policy-makers firmly placed climate change politics within the boundaries of the political sphere. This implies that scientists have had a marginal influence on setting the current national emission target. It does not have to mean that policy-makers disregard scientific knowledge, but rather that uncertainties are deemed too large; that no knowledge brokers are available; or that the framings knowledge brokers have made are not useful in a political context.

Scientific uncertainty in the policy process

As evident in the studied case, the most common approach to manage scientific uncertainty in the policy process was to focus on knowledge and politics, in other words on what was seen as politically possible actions. As stated, this should not be a surprising result for anyone with an incremental perspective. Therefore the so-what question could be called for. However, the belief in rational decision-making is still very strong, which means that scientific uncertainty is seen as a larger problem than it is. This can affect science policy in different countries and can also affect individual policy-makers' use of uncertainty as a reason to postpone unwanted decisions. Even if we ought to have learnt from earlier research, there seems to be a need to repeatedly point out the limits of rational policy-making (cf. [Tenbenschel 2004](#); [Botterill and Hindmoor 2012](#)). What especially needs to be studied is how policy-making is actually done and how the relation between science and politics influences it. Studies that are sensitive to this interaction might generate new insights that can advance policy studies, as well as give advice on how the interaction between science and politics can be structured.

This study throws light on the processes involved in framing and using uncertain knowledge, which are more complex than is often recognised. Two crucial conclusions can be drawn from the study. The first is that in order to understand policy-making under uncertainty, it is not enough to study how policy-makers use scientific knowledge to make decisions ([Ginsburg and Gorostiaga 2001](#); [Schrefler 2010](#)) or what knowledge is available ([Boswell 2012](#)). We need to pay closer attention to the interplay between use and production. I have argued that scientific knowledge cannot be seen as available to policy-makers until it is framed in a political context by knowledge brokers. Scientific uncertainty seems to make scientists less willing to act as knowledge brokers. This can be explained by the discourse of neutral science, as

based on the ideas of among others Merton (1973). Scientists are trained not to draw conclusions from uncertain evidence. When they act as knowledge brokers on uncertain knowledge, they do exactly that. It is not uncommon that knowledge brokers are criticised by fellow scientists for being inappropriately political. However, what the study shows is that when scientists make what can be seen as political claims, they will have a larger influence. The example of how scientists suggested a two degrees target is an example of this. What also seems to be important for scientists' influence on political decisions is scientific credibility and their connection to policy circles (cf. Haas 1989). The conclusion here is that it is not the quality of scientific knowledge that is important for policy-making, it is rather if it is framed in an accessible way. The scientists who suggested the two degrees target framed knowledge as highly uncertain and in need of constant revaluations. Despite this uncertainty, policy-makers chose to trust the scientists' judgement. It is not policy-makers who have difficulties with scientific uncertainties, but scientists in their capacity as knowledge brokers.

The second conclusion that can be drawn from this study is that framings of scientific uncertainty affect policy-making in different ways, depending on if it is connected to understanding the problem or what to do about it (cf. Kingdon 1984). In defining the problem as political, scientific knowledge has been highly important, even though it has been uncertain. Especially the framings of the IPCC have been influential. Policy-makers have chosen to trust scientists in their judgement that climate change needs to be managed politically. Even though uncertainties were large, policy-makers accepted that anthropogenic emissions led to climate change and that the risks with the change were too large. Scientists' influence on the perception of the problem can be understood as a natural effect of climate change being perceivable only with help of science. Scientific uncertainty can here be seen to strengthen scientists control over the problem definition. By highlighting uncertainties in their framings, scientists can indicate that an issue needs to be studied further. Thereby, they maintain the right to define it. For example, by framing uncertainty as under control and possible to decrease, scientists can create 'certainty about uncertainty' (Shackley and Wynne 1996, 281).

The situations in which scientific knowledge and uncertainty were less important consistently concerned how to deal with climate change and what policies to adopt. Scientists pointed out that greenhouse gas emissions needed to be decreased, but were unable or unwilling to give a more precise number to base political decisions on. As discussed above, scientific uncertainty reinforces the characteristics of science that makes scientists reluctant to act as knowledge brokers. When deciding on particular policies, policy-makers tended to take their point of departure in what was politically feasible, for lack of more specific scientific advice. This led to an incremental policy-making.

The internal dynamics of science and politics, as discussed, are reasons to believe that the main results of this study are valid also in other countries and for other issues that are scientifically framed. However, we could expect to find differences in how scientific uncertainty affects the policy process depending on structure of the relation between science and politics, and through that, the availability of knowledge brokers and politically framed knowledge.

Conclusion

This article argues that we need to go beyond the simple understanding of the relation between science and politics found in rational accounts of policy-making. In order to understand complaints by scientists that policy-makers do not listen and the allure of evidence-based decision-making, we need to study this relation in more detail. If we do, we see that more research for different reasons does not necessarily lead to better decisions. In some cases, better knowledge is simply not attainable or takes too long to produce. More knowledge, where it is possible, can also strengthen political conflict. The finding of this study is that what is lacking is not so much knowledge, as knowledge that can be used as policy advice. In the Swedish climate change policy process scientific uncertainty was an obstacle for scientists to act as knowledge brokers, whereas policy-makers, for lack of policy advice, resorted to knowledge about the political system and what were politically possible actions. The constructed typology of policy-makers' approaches to scientific uncertainty has revealed that policy-makers tended to focus on knowledge and politics rather than on uncertainty and science, which would be the assumption within the rational tradition. The question is if the 'rational' strategy would be better for policy-making. The answer must be that more scientific knowledge to a certain point has to be seen as good, even if it only makes it easier for scientists to act as knowledge brokers. However, more knowledge should not be used as a panacea to uncertain problems, as the knowledge needed might not be attainable at all or in time for decision-making. Policy-making in those instances has to rely on 'muddling through'.

Note

1. The study has previously been presented in more detail in Swedish in Knaggård (2009).

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