

Provided for non-commercial research and education use.  
Not for reproduction, distribution or commercial use.



This article appeared in a journal published by Elsevier. The attached copy is furnished to the author for internal non-commercial research and education use, including for instruction at the authors institution and sharing with colleagues.

Other uses, including reproduction and distribution, or selling or licensing copies, or posting to personal, institutional or third party websites are prohibited.

In most cases authors are permitted to post their version of the article (e.g. in Word or Tex form) to their personal website or institutional repository. Authors requiring further information regarding Elsevier's archiving and manuscript policies are encouraged to visit:

<http://www.elsevier.com/copyright>

available at [www.sciencedirect.com](http://www.sciencedirect.com)journal homepage: [www.elsevier.com/locate/envsci](http://www.elsevier.com/locate/envsci)

## Enhancing the use of science in environmental policy-making and regulation

John Holmes<sup>a,\*</sup>, Rebecca Clark<sup>b</sup>

<sup>a</sup> Department of Earth Sciences, University of Oxford, Parks Road, Oxford OX1 3PR, UK

<sup>b</sup> Natural England, 122a Thorpe Road, Norwich NR1 1RN, UK

### ARTICLE INFO

Published on line 30 September 2008

#### Keywords:

Environment  
Science-into-policy  
Interpreter  
Regulation  
Policy-making

### ABSTRACT

Over the last 10 years the UK Government has strongly promoted the more effective use of science to inform policy-making and regulation. In response, the Environment Research Funders' Forum (which brings together the main UK Governmental funders of environmental research) has carried out studies, reported in this paper, to establish what is working, what is not, and why in respect of the linkage between science and environmental policy-making and regulation.

The findings indicated that there was potential to improve effectiveness in: establishment of research questions and agendas, accessing information and expertise, the role of interpreters, and transparency and evaluation. These findings are re-enforced by those of previous studies conducted in the UK and EU. The studies found that current practice in using science to inform policy-making has not yet caught up with guidance, and they identified potential actions that could be taken by the Forum and its members to narrow the gap.

© 2008 Elsevier Ltd. All rights reserved.

### 1. Introduction

The Environment Research Funders' Forum (ERFF) brings together the main UK Governmental funders of environmental research – the Research Councils, together with Government departments and agencies responsible for environmental policy and regulation – to improve the coordination and effectiveness of research funding (see [www.erff.org.uk](http://www.erff.org.uk)). Together, ERFF members have an annual research budget of over £500 m (ERFF, 2007).

The expectation of the Research Councils (public bodies charged with investing tax payer's money in science and research in the UK in order to advance knowledge and generate new ideas), Government departments and agencies comprising ERFF is that such increased knowledge, and its effective use, will lead to better policies and regulatory decisions (see for example Environment Agency, 2004; Defra, 2005; Food Standards Agency, 2006). The motivation for much of this research is to

increase the knowledge on which environmental policies and regulatory decisions may be based. The Forum and its members therefore have a strong incentive to enhance the use of science in environmental policy-making and regulation.

This paper summarises studies undertaken by ERFF of the use of science for environmental policy-making and regulation in the UK to establish what is working, what is not, and why. The aim of the studies has been to inform decisions by ERFF and its members on actions to improve the effectiveness of science in informing environmental policy-making and regulation. They addressed a broad range of issues associated with the science–policy interface. Key issues are summarised in this paper under four headings:

- establishing research questions and agendas;
- accessing information and expertise;
- the role of interpreters; and
- transparency and evaluation.

\* Corresponding author. Tel.: +44 1865 272058; fax: +44 1865 272072.

E-mail address: [John.Holmes@earth.ox.ac.uk](mailto:John.Holmes@earth.ox.ac.uk) (J. Holmes).

1462-9011/\$ – see front matter © 2008 Elsevier Ltd. All rights reserved.

doi:10.1016/j.envsci.2008.08.004

While the main focus is on the UK, findings of the studies are reviewed against parallel studies conducted at a European level (Scott et al., 2005; Scott et al., 2006; Holmes and Savgard, 2008).

The concerns of ERF member organisations (and hence of the studies summarised in this paper) cover a wide span:

- of environmental issues including management of resources, environmental quality and flood risk, and mitigation of, and adaptation to, environmental change;
- policy and regulatory decision making at international, national and local levels; and
- urgent decisions and responses through to long term and strategic work to establish overall policy goals and frameworks.

Science is used to inform work in all these areas, drawing on relevant disciplines from natural, physical and social sciences. Applications range from synthesis of existing knowledge, through applied, to basic research depending on the timescales and context. Its use may be instrumental (for example providing the basis for decisions on flood management schemes or permitting of atmospheric discharges) or conceptual (for example exploring the meaning of, and means to achieve, sustainable consumption and production).

The background to the studies is presented below, followed by the rationale and approach. The findings are summarised and compared against those of other studies in the UK and Europe in Sections 4–7. Discussion and conclusions sections then complete the paper.

## 2. Background

UK Governments' concerns to make better use of evidence in policy-making may be traced back several decades (Wyatt, 2002). However, fresh impetus was given in 1999 by the publication of the Modernising Government White Paper (HM Government, 1999) which gave a commitment to improve the way in which policy is made, including better use of evidence and research. Tony Blair declared (Wyatt, 2002) that "what counts is what works" intending to signal the end of ideologically driven politics and herald a new age, where policy-making would be driven by evidence (particularly evidence from research) (Nutley, 2003) and there would be an emphasis on data rather than dogma (Shaxson, 2005). The subsequent document "Professional Policy-Making for the 21st Century" (Cabinet Office, 1999) set out nine characteristics of good policy-making of which "uses the best available evidence from a wide range of sources" was one.

An added edge to concerns to improve the use of scientific evidence in policy-making was provided by the report of the Government inquiry into BSE (Phillips, 2000). In respect of the Government's management of issues relating to BSE, it criticised the way in which scientific advisory committees and advice had been used, the lack of openness in the scientific advisory process, and the absence of a consistent and proportionate approach to risk management.

Although it is argued that the UK has been distinctive in its emphasis on evidence-based policy-making (Solesbury, 2001), similar concerns and initiatives can be observed internationally

in the years following publication of the Modernising Government White Paper. A commitment by the European Commission to better policy-making (European Commission, 2001) was followed by a Science and Society Action Plan (European Commission, 2002a) concerned, amongst other things, with putting "responsible science" at the heart of policy-making, and the publication of guidelines on the use of scientific expertise by the Commission (European Commission, 2002b). Studies of environmental ministries and regulators in European Union member states (Scott et al., 2005; Holmes and Savgard, 2008) reveal their increasing emphasis on the effective use of science in policy-making and regulation. Parallel developments in countries further afield include Australia (Marston and Watts, 2003), Canada (Bielak et al., 2008) and New Zealand (Parliamentary Commissioner for the Environment, 2004).

It may be relatively uncontroversial to propose that environmental policies informed by an understanding of the relevant natural and social systems are more likely to achieve their goals than those that are not. However, the principles and practice of "evidence-based policy" are rather more contested. For example, Parsons (2002) questions whether research can provide objective answers to policy questions and whether policy-making can become a more rational process, and asserts that "evidence-based policy-making (EBPM) is a missed opportunity for improving government and has only served to make the relationship between knowledge and policy-making in a democratic society *more muddled rather than less confused*".

Rayner (2006) points out that science may raise new questions making policy less, rather than more tractable, and contradictory views founded on different interpretations of the science may lead to unproductive arguments whereby scientific inputs are cancelled out and political or economic interests prevail. Similarly, Owens et al. (2006) remind us of the social and political research which has exposed the complexities of knowledge and policy processes, and the shortcomings of "the linear-rational model in which 'sound science' is straightforwardly translated into policy." They suggest that it is more helpful "to think in terms of a continuum of influence and utility, ranging from clear and immediate impacts to long term, subtle processes in which problem definitions and modes of thinking change".

It is argued (Nutley, 2003) that "evidence-based" rather overstates the sensible aspiration of policy-making; rather, "evidence-informed" or "evidence-aware" would be more appropriate. This sentiment is picked up in the recent House of Commons Science and Technology Committee (2006b) inquiry into the use of scientific evidence and advice in UK Government policy-making, which calls for a more honest approach in acknowledging the influence of other factors in policy decisions. As Wyatt (2002) points out, "evidence-based" policy has been adopted as a shorthand term which does not do justice to the more nuanced approach set out by the Cabinet Office (1999). This document summarises the core competencies of good policy-making including "using evidence" which is described as, "uses best available evidence from a wide range of sources and involves key stakeholders at an early stage". Other competencies include "to be outward looking" requiring account to be taken of factors in the national, European and international situation.

The Cabinet Office (1999) defines evidence to include stakeholder consultation, expert knowledge and the “critical evidence held in the minds of front line staff in departments, agencies and local authorities and those to whom the policy is directed”. This is broader than Hammersley’s (2005) interpretation that evidence-based policy-making narrows the field of legitimate evidence to “research evidence presented in the form of systematic reviews”.

In practice, UK Government departments and agencies may be considered to take a pragmatic approach. From Haas (2004) we can speak of “useable knowledge” which “encompasses a substantive core that makes it useable for policy-makers, and a procedural dimension that provides a mechanism for transmitting knowledge from the scientific community to the policy world...”. UK Government guidelines issued in 2005 (updating guidelines published in 1997 and 2001) describe “how evidence should be sought and applied to enhance the ability of government decision makers to make better informed decisions” (Office of Science and Technology, 2005).

Several studies over the period 1999–2003 revealed a fairly consistent picture of the state of play in the use of science in UK Government policy-making (Cabinet Office, 1999; Bullock et al., 2001; Office of Science and Technology, 2001; National Audit Office, 2003; Commission on the Social Sciences, 2003). They pointed to a need for:

- a cultural change with a new mindset towards policy-making;
- policy makers to become more intelligent customers, better able to define questions to science and reflect uncertainties appropriately in policy formulation;
- improvements in the ability of researchers to communicate findings to policy makers in a useful form and more incentives to do so; and
- more time, resources and analytical capacity to enable the science–policy interface to work more effectively.

It was against this background that the Environment Research Funders Forum decided in 2005 to initiate the studies described in this paper.

### 3. Methodology

The research was conducted in two phases:

- A scoping study (Holmes, 2005) to identify key issues that need to be addressed to enhance the use of science in environmental policy-making and regulation. This identified interpretation as an important area requiring further investigation.
- A more in-depth study (Clark, 2007) building on the findings of the scoping study, which focused on investigating the role of interpretation—the processes through which policy-makers request and obtain information from research.

A short literature review was conducted at the start of each of the phases to help identify pertinent issues and shape the research. Data were collected through interviews conducted with 152 people in total. In phase 1, the scoping stage,

interviewees were purposefully selected by the researcher to provide a broad range of viewpoints and to cover different roles relating to the science–policy interface in a wide range of organisations. The 70 interviewees were drawn from 16 Government departments and agencies, 3 Research Councils, 10 universities and research institutes, and 7 other organisations such as professional bodies and research networks.

Phase 2, the in-depth stage, focussed largely on staff in ERFF member organisations. People who develop or implement policy and regulations and technical advisers comprised just over half the sample (82 people in total), researchers, research managers and communications officers the majority of the rest. The interviewees were purposefully selected by the ERFF representative in each organisation who either nominated staff or invited staff with relevant roles to volunteer as interviewees. Purposive sampling was more feasible than random sampling for both phases of the research. While the samples were judged by the steering groups set up to oversee each phase to represent a well-balanced cross section of the relevant population, it is possible that such purposive sampling may have resulted in non-reporting or insufficient prominence being placed on some issues and views

Both of the studies employed semi-structured interviewing. Most interviews were conducted face-to-face (some by telephone), and on a one-to-one basis (some with small groups) at the interviewee’s place of work. Interviewees were provided in advance with information on the research and a brief overview of the issues being explored to enable them to prepare. They participated in the study on the understanding that their contributions would remain anonymous.

In phase 1, interviewees were asked to identify and describe issues that they felt needed to be addressed to enhance the use of science in environmental policy-making and regulation. Questions in phase 2 were more focussed and covered, amongst other things, how scientific evidence is sourced and communicated, the commissioning of research, mechanisms for keeping informed of new evidence, and the role of interpreters and the skills involved. Because the data were reported by participants (and not observed) they were influenced by participants’ perceptions of interpretation and their views on the study and what it might achieve. Semi-structured interviewing was used to enable interviewees to volunteer relevant (and pet) issues but also provide coverage of other key issues (identified by the researchers) through use of a checklist.

In phase 1, the researcher took written notes of the interviews and produced a synthesis of the key issues raised by the interviewees. To enable the more detailed analysis required for phase 2, digital recordings were made of the interviews and converted into written transcripts by transcribers. This information was supplemented by 22 responses to an e-mail survey of 192 people in organisations that are not ERFF members asking for their views on interpretation in the UK. The data were analysed using NVivo software.

Data collection and analysis for both phases were shaped by the researchers’ understandings of the use of science in policy and of interpretation. This understanding was informed by the literature, discussions with ERFF representatives and the researchers’ previous experience. The findings of phase 1 were used to develop a definition of interpretation that guided



the in-depth research in phase 2. In both phases workshops were used to test and refine initial findings. Similarly, the steering groups provided a useful sounding board for testing the analyses and conclusions.

Subsequent sections of the paper summarise the findings of the two studies under four headings: establishing research questions and agendas; accessing information and expertise; the role of interpreters; and transparency and evaluation, and reflect on these in relation to the findings of other studies conducted of the UK and European Union. Further detail can be found in Holmes (2005) and Clark (2007).

#### 4. Establishing research questions and agendas

Interviewees in the two studies identified that establishing research questions and agendas is a key stage in the use of science in policy-making. However, a number of problems are frequently encountered in this concerning:

- strategic use of evidence from research;
- framing of policy questions;
- stakeholder engagement; and
- the purpose of the research.

##### 4.1. The strategic use of evidence from research

Several interviewees felt that the findings of research tend not to be involved early enough in establishing policy priorities. Scientific evidence should be tuned into the “front wave of the environmental debate” and provide a creative stimulus to policy formulation. It should also be drawn on in establishing the Government’s bigger strategic questions, which typically originate in the Treasury or the Cabinet Office. More use of systematic analysis of environmental pressures, and of outputs of current horizon scanning initiatives would enable science to better inform the policy agenda. More could also usefully be done to draw together current horizon scanning initiatives of individual departments and agencies.

Evidence to the House of Commons Science and Technology Committee (2006b) inquiry echoed the concern that science is not involved sufficiently early in the policy process. Similarly, Campbell et al. (2007) found that few policy officials interviewed for their study could give examples where scientific evidence had been used to establish the need for policy.

##### 4.2. Framing of policy questions

Many participants in ERFF’s studies expressed concern that policy-makers can have difficulty in posing research questions that effectively inform choices between policy options. Their questions tend not to be “big” enough and to be too short term. Constraining assumptions can be hidden, for example associated with the scientific or decision model. Also, several contributors expressed concerns that the economists’ perspectives dominate departments’ thinking at the expense of other considerations. Participants considered that in general insufficient time is devoted to the anticipation of issues

requiring research, and to establishing what is already known prior to initiating research projects. As reported in Owens et al. (2006), this can lead to Government departments and agencies commissioning essentially the same research at different times.

These issues are recognised by the UK Government’s Department for Environment, Food and Rural Affairs’ (Defra’s) Science Advisory Council (2006), which points to the need for close involvement of policy-makers in the question-setting process and the importance of avoiding becoming “locked-in” to historical scientific framings of problems. A Europe-wide evaluation of research programme management practices for a network of environmental ministries and regulators (Holmes and Savgard, 2008) identified recurrent difficulty in getting policy-makers and other research users to devote quality time to working up research programmes and projects.

##### 4.3. Stakeholder engagement

Effective public engagement to inform the framing of research questions was identified by interviewees as important but particularly difficult on sensitive issues. Deliberative and inclusive approaches have been consistently promoted over the last 10 years by Government advisory bodies and independent observers (Irwin, 1995; Royal Commission on Environmental Pollution, 1998a,b; House of Lords Select Committee on Science and Technology, 2000; Council for Science and Technology, 2005) but have not yet been widely adopted by Government departments and agencies. Approaches to stakeholder engagement require further development to be effective within resource and time constraints. One participant in the research indicated that “there is a lack of understanding by policy-makers of what is at stake in many public controversies”, in particular understanding of the public’s assumptions, values and concerns, and how they should be reflected in the framing of the research questions.

Studies at the European level (Scott et al., 2005, 2006; Holmes and Savgard, 2008) re-enforce these findings, pointing to the need for sustained engagement between researchers, policy “customers” and other relevant stakeholders from the question framing stage, through the research process itself to the interpretation and uptake of the research results. They recommend that researchers develop a more “rounded” appreciation of the problem, which enhances the relevance and quality of the research and leads to better policy-making and learning.

##### 4.4. The purpose of the research

A significant proportion of the research funded by the UK Research Councils (major funders of research in the UK) is intended to be policy relevant. Interviewees expressed concerns that this research too often fails to provide sufficiently coherent and effective research outputs to inform policy-making. This is not aided by disincentives for many researchers to undertake policy relevant research.

Participants thought that sharper delineations were needed between research with different purposes and better mechanisms were needed to ensure uptake of research that is intended to be policy-relevant. This could be achieved through

greater participation of “end-users” in defining research programme scope and objectives through networking, consultations, workshops and steering committees.

Recent studies of knowledge transfer by the Research Councils came to similar conclusions about the need for, and nature of, changes in the Research Councils' approaches to programme planning and management (House of Commons Science and Technology Committee, 2006a,b; Research Council Economic Impact Group, 2006). Similar concerns about science being useful for policy have been expressed about carbon cycle research in the US (Dilling, 2007), and the scientific advice provided to European Commission fisheries managers (Delaney and Hastie, 2007). This has been addressed in Sweden for carbon cycle science by including research users on the board of the research council programme (Lövbrand, 2007).

## 5. Accessing information and expertise

Effective access to information and expertise is a necessary precursor to the use of science to inform policy-making and regulation. Policy-makers and their scientific advisers who participated in the study raised a number of concerns about current practices in particular in relation to:

- finding reports and papers;
- assessing the reliability of information; and
- establishing contact with experts.

### 5.1. Finding reports and papers

Interviewees considered that reports produced by and for Government departments and agencies (in the UK, in other countries and by the European Commission) were more likely to be policy relevant than academic research because they are commissioned to address policy issues and the projects are generally managed by someone familiar with policy. But, notwithstanding initiatives across Government in recent years to make such reports available (typically as PDF downloads from department and agency web sites), these reports can be difficult to find. Campbell et al. (2007) report similar concerns.

More generally, interviewees felt that the outputs from all Government-funded environmental research – including that funded by the Research Councils – should be readily available. The ideal would be a single database or a single web entry point that could be used to search for, and access, reports on all policy-relevant environmental research. It would be searchable by policy issue and provide e-mail alerts according to a user's pre-registered profile of interests. Policy-relevant research reports should include an executive summary that summarises key findings upfront, describes the context, reliability and implications for policy and is written so that it is understandable by lay people. All this is particularly important given the time pressures faced by policy makers and their advisers. Consequently, as one adviser described the present position, “[we are] only capturing the tip of the iceberg on key information”.

Consistent with the findings of Walter et al. (2003), the ERF study found that policy makers tend to make relatively little use of papers published in peer reviewed journals as sources of

research evidence. Most papers tend to be too focused, technical and detailed, and policy-makers do not have the time to read the number of papers needed to develop an overall understanding of an issue. The exceptions are papers that review the current state of knowledge on an issue – these are valuable sources of information for policy-makers. However, some interviewees expressed concern that Government departments and agencies do not provide them with adequate and sufficiently rapid (preferably electronic) access to relevant journals. Consequently, a substantial part of the peer reviewed literature is effectively not visible to policy-makers. In contrast, grey literature – including reports prepared by and for Government – is available (notwithstanding the difficulties in finding reports).

Similar findings have been made in EU-wide studies. Scott et al. (2005, 2006) report on the need for more effort to be put into making research outputs accessible. This includes synthesis of what is known in relation to policy issues and the development of better, searchable databases that include ‘plain language’ summaries as well as the more detailed technical reports. The European Thematic Network on Air Pollution and Health (Totlandsdal et al., 2007) provides a useful example of how some of these issues can be addressed, for example by the transfer of research findings to users through a centralised online database of current and past research projects and through alerts that inform users of new research findings, giving a lay summary of the findings and their policy-relevance.

### 5.2. Assessing the reliability of information

Assessing the reliability of information in grey and peer reviewed literature was a general concern for policy-makers who participated in the study, as found also by Campbell et al. (2007). The criteria they use to assess reliability, on a rather ad hoc basis, include:

- the reliability of the techniques used for the analysis;
- the reputation of the organisation and researcher;
- whether the work has been peer reviewed; and
- the quality of material, for example whether it covers the bases and hangs together as a coherent story.

These are similar to those reported by the policy officials who contributed to the study by Campbell et al. (2007).

Some interviewees expressed a desire for written material to be accompanied by an assessment of its reliability, for example “if research reports came with a stamp: ‘This is good’ ‘This is robust’, ‘9 out of 10 cats prefer this research methodology’, that sort of thing, that might be helpful”. Some also thought that it would be useful if a common set of criteria and guidelines was developed that can be used generally to assess the reliability of information for use to support policy-making and regulation. This is re-enforced by the House of Commons Science and Technology Committee (2006b) which concluded that “it is necessary for there to be a more formal and accountable system of monitoring the quality of the scientific evidence provided and the validity of statements by departments of the evidence-based nature of policies.” Initiatives to develop evaluation criteria for the quality of research for informing policy include work carried out by the UK Centre for Evidence

Based Policy and Practice (Boaz and Ashby, 2003) and the development by Defra of a set of criteria to evaluate the “robustness” of evidence for policy (Shaxson, 2005).

The issue of quality also manifests itself in reviews of the current state of knowledge in relation to a policy issue. Notwithstanding debates about their utility and primacy (e.g. Hammersley, 2005; Chalmers, 2005), there is increasing interest in the use of systematic reviews drawing on methods used in medicine, for example by the Cochrane Collaboration (as discussed in Pullin and Knight, 2001; Boaz et al., 2002). The Centre for Evidence Based Conservation (<http://www.cebc-bangor.ac.uk/>) has extended these methods to environmental issues (Pullin and Stewart, 2006) and has conducted reviews on policy issues (such as the effectiveness of marine protected areas) and environmental management topics (such as the siting of wind turbines).

### 5.3. Establishing contact with experts

External experts (including researchers, consultants and experts in other Government departments and agencies) are an important source of scientific advice for the interviewees. These experts synthesise and interpret information for policy-makers and their involvement may lend credibility to the ensuing policy decision. They make input as individuals or as members of advisory committees. Policy-makers can find it difficult to know who the experts are on an issue, particularly if the issue is new to their policy team, a problem that is exacerbated by the turnover of staff in policy teams, which is a feature of the UK civil service. There is a tendency to rely on existing contacts, but the Chief Scientific Adviser's guidelines (Office of Science and Technology, 2005) require that staff “cast their net wider than their traditional contacts and continually establish new networks in order to capture the full diversity of evidence-based advice”.

Participants expressed the need for a searchable database or register of experts which would include the information necessary to assess individuals' credentials for providing advice. Ideally, professional bodies, learned societies and charities would be involved as their memberships constitute a source of expertise that is currently underutilised in the policy arena.

It can also be difficult for researchers to know who in Government departments and agencies might use their

research and so should be engaged in it. And across Government, it can be hard for policy-makers to find out who is working on particular policy issues. Participants considered that some kind of searchable database of the points of contact for individual policy issues in Government departments and agencies would be useful.

Interviewees stressed the value of meeting useful contacts (both experts and policy-makers) as it makes it easier to contact them subsequently. This points to the need to create more opportunities for members of the research and policy communities to meet and interact.

The view was also expressed that a strategic overview should be taken to ensure that the UK has a “healthy” system for science input to policy, in terms for example of the accessibility of expertise, diversity of inputs, and productivity of dialogue.

## 6. The role of interpreters

The need to enhance the quality of interaction between researchers and policy-makers (to create more “social capital” as described by McNie, 2007) was a point made in different ways by participants in the studies. Differences between researchers and policy-makers in their cultures, time-frames, reward structures and motivations were identified as obstacles to good communication, with time pressures exacerbating the difficulties. Table 1 summarises the barriers to better interaction identified by participants in the baseline study.

Recognising that there is often a gap between the researchers and policy-makers, participants felt that there is a distinctive role for interpreters to facilitate interactions between them. The following paragraphs consider:

- the role of interpreters in the science-policy interface;
- the UK's interpretation capacity; and
- skills and training.

### 6.1. The role of interpreters in the science-policy interface

Participants in the studies highlighted the important role played by interpreters in the interface between science and policy. The role of these interpreters includes:

**Table 1 – Barriers to improved interaction between scientists and policy makers**

Researchers need to:

- Take a broader view, and be able to take the viewpoint of the policy maker, seeing how their work fits in
- Recognise the difference between what is good enough for policy as distinct from publication
- Understand the role of scientific advisor as explanation, not advocacy
- Understand what is helpful to the policy maker and not over-inflate the value of their scientific results
- Reject as false the dichotomy of being a “proper scientist” or a science advisor
- Recognise that science is just one factor in the policy decision

Policy makers need to:

- Be more receptive to science, providing more policy pull
- Overcome being scared of evidence which “makes life too complicated” or conflicts with the desired policy line
- Avoid being unduly confident in the answer received from the scientist
- Resist the temptation to cherry-pick the results and opinions that back the desired policy line
- Address the low levels of understanding of science by many career civil servants

- describing to policy-makers the policy implications of research findings. This includes insights offered by the findings for the identification of, and discrimination between, policy options;
- facilitating the development of researchable questions to meet policy needs and communicating these to researchers; and
- providing an up-to-date balanced overview and synthesis of what is known, and what are the key uncertainties, in relation to a policy issue.

The roles of the interpreter as “science arbiter” and “honest broker of policy alternatives” are also described in Pielke (2007).

Within Government departments and agencies, in-house scientists very often undertake the role of interpreter (as discussed in OXERA, 2000), alongside responsibilities for the planning, commissioning and management of research projects. This is also recognised by Campbell et al. (2007), who recommend that Government analysts should become better “knowledge brokers” and “develop skills in taking all the available evidence and drawing out the salient points in a summary...”. Defra’s Science Advisory Council (2006) reinforces the interpretation role of staff who are responsible for research projects. It recommends that these staff should take the lead in preparing a briefing note on the project (in consultation with the policy customer and research contractor) that interprets the project findings, setting out the limitations and implications of the research findings for policy.

Other bodies may also undertake interpretation activities including science advisory committees, Governmental research institutes, learned societies, consultancy firms, and think tanks, and are sometimes described as ‘boundary organisations’ for this reason (Guston, 2001; Owens, 2005; Lorenzoni et al., 2006). Researchers and policy-makers themselves may also sometimes carry out elements of the interpreter’s role.

## 6.2. The UK’s interpretation capacity

Policy-makers who participated in the studies expressed concern about the UK’s interpretation capacity both within and external to Government departments and agencies. Current initiatives to slim-down civil service structures mean that in-house scientists, who usually provide interpretation in Government departments and agencies, are increasingly over-stretched. The House of Commons Science and Technology Committee (2006b) had the same concerns and felt that reductions in staff numbers within Government departments

was leaving departments vulnerable to being unable to ask the right questions and to becoming uncritical, unquestioning consumers of the scientific advice they receive. The Committee also criticised “The Government’s failure to do enough to address the implications of the privatisation of Public Sector Research Establishments for the scientific capacity of the civil service...”. The Office of Science and Innovation’s review of Defra (2006) expressed “concern among external stakeholders that Defra is failing to maintain internal scientific expertise”.

Interviewees also pointed to disincentives for researchers to engage in interpretation for policy-making. They attributed this to the emphasis placed on academic publication in the Research Assessment Exercise and in academia more generally. A researcher’s peer group may look down on researchers who communicate their work to lay audiences (as one interviewee put it, peers may say “People who do that haven’t quite cut it as a scientist”), and time spent on interpretation work may well be at the expense of the publication record that a researcher requires to progress his or her career.

An important conclusion of the studies is that a more systematic approach is needed to establish the need for, and to provide, interpretation capacity within and external to Government departments and agencies.

## 6.3. Skills and training

Participants in the studies thought that training is needed to develop interpretation skills in researchers and relevant staff in Government departments and agencies. Consideration also needs to be given to defining and enabling careers for interpreters in order to attract high calibre individuals with the necessary skills. Table 2 summarises the characteristics and skills of good interpreters identified by interviewees, one of whom summarised things succinctly “it’s a different role which ought to have its own prestige because there are a hell of a lot of scientists who don’t understand how to translate what they’re doing into something that the rest of the world understands”.

At a European level, Scott et al. (2005, 2006) and Holmes and Savgard (2008) point to the role of interpreters – “a new race of ‘translators’ is needed to help bridge science and policy” – and identify distinctive skills consistent with those in Table 2.

## 7. Transparency and evaluation

Behind the issue of transparency lies a concern expressed by several participants that the science into policy process must engender trust—seen as increasingly important in a society

**Table 2 – The characteristics and skills of good interpreters**

<p><i>A background in natural or social sciences (as appropriate):</i> this is necessary for the interpreter to understand the information they are interpreting, to be able to communicate effectively with researchers and to have credibility. They should understand how research is done and have a critical appreciation of research findings</p> <p><i>Good communication skills:</i> both written and oral, and ability to communicate effectively with different audiences, simplifying information as appropriate and presenting it clearly</p> <p><i>Good inter-personal skills:</i> ability to relate to a wide variety of people, appreciating different points of view, and have good influencing skills</p> <p><i>Experience of policy work:</i> an appreciation of how policy makers work</p> <p><i>Aware of the bigger picture:</i> widely knowledgeable and able to see links between issues. Understand the different perspectives on an issue, where evidence is weak or strong, and what research is underway</p> <p><i>Good at using judgement:</i> able to draw conclusions and make recommendations on the basis of incomplete information</p>
--



that is more questioning and where everything is open to challenge. Transparency of the evidence base and its use is essential to successful partnerships in policy advocacy. This is enabled by involvement of stakeholders from the research stage onwards as a prerequisite of buy-in and consensus.

Several policy-makers pointed to the need to establish clearer “audit trails” to record how science is used in policy-making. While progress has been made in making research reports and the working of advisory committees available, explanations of how policy decisions rest on evidence remain rather patchy.

The *House of Commons Science and Technology Committee (2006b)* also calls for “more transparency in the scientific advice and public involvement which influence policy” and recommends that “A strong emphasis on the publication of all evidence used in policy-making, along with a clear explanation of how it is used, should be one of the guiding principles of transparent policy-making.” In its review of the Department, the *Office of Science and Innovation (2006)* recommended that “Defra should make its science more open to challenge...” and *Defra’s Science Advisory Council (2006)* recommended that Defra should more systematically “record how the outputs of individual science projects have been incorporated in policy...”

Participants in the studies identified *evaluation* of the uptake and impact of research as important but difficult. As one senior researcher explained “it’s very difficult to assess the value of somebody’s input to government policy-making and it is much easier to count papers...”. Quality assurance and evaluation systems within Government departments and agencies can have too narrow a focus and need to be extended to the full process of using science to inform policy including the formulation of research questions and uptake of research findings. For example, the *Office of Science and Innovation (2006)* expressed concern that “There is little evidence that Defra has yet achieved much in terms of evaluating whether, and how effectively, science has influenced policy...”. In terms of informal evaluation, people who provide interpretation, both in-house and externally, expressed a desire for more feedback on the quality and usefulness of their inputs to the policy-making process.

In other European countries, evaluation of the uptake and impact of research on policy has been found to be similarly neglected (*Scott et al., 2005; Holmes and Savgard, 2008*), albeit with some exceptions, for example in the environmental ministries in Finland and the Netherlands.

## 8. Discussion

A rather consistent picture emerges from the many individuals and organisations that contributed to the ERFF studies. It resonates well with that given by recent studies of environmental ministries and regulators across Europe (*Scott et al., 2005; Holmes and Savgard, 2008; Holmes and Lock, 2008*), perhaps not surprising as they face similar challenges. But this is somewhat at odds with commentators who position the UK as rather distinctive in its pursuit of an evidence-based approach to policy (*Solesbury, 2001*).

Analysing the different views of this picture, there is little to differentiate the perspectives and concerns of policy

makers and regulators, potentially because their fields of operation overlap on a continuum from Government policy-making through to decision taking in the implementation of policy and regulation. There is rather more that distinguishes their views from those expressed by people working in the Research Councils and research organisations. There is a sharing of ‘top-down’ concerns to enhance the benefit to policy and regulation derived from the UK’s investment in environmental research. However, the underlying currents that determine the everyday actions of people who conduct research and people involved in making policy are not yet appropriately aligned. The need for alignment is particularly acute in that middle zone of strategic research intended to underpin future policy-making, which sits between blue skies research on the one hand (traditionally funded by the Research Councils), and near-term research, synthesis and advice on the other (appropriately commissioned by Government departments and agencies to support their current activities).

A particular value of the studies is that they have strengthened, and brought up to date, the evidence base on how things are working (or not working) in practice for environmental policy-making and regulation in the UK. As such, they have provided the basis for consequent initiatives by ERFF and its members to address some of the problems identified. ERFF sponsorship has provided an unusual level of access to ‘front line’ staff who have been candid in their inputs, enabling these studies to usefully augment more theoretical studies conducted remotely from the ‘coal face’.

Notwithstanding terminology that is unhelpfully over-compressed such as ‘evidence-based policy’, ERFF’s studies reveal a more pragmatic and realistic aspiration to strengthen the use of science, and evidence more generally, in what those front line staff recognise all too well as the messy reality of policy-making and regulatory decision taking. Digging below the surface of some of the academic debates referred to earlier in the paper about how the policy process is, and should be, conducted (for example, *Parsons, 2002; Haas, 2004; Owens et al., 2006; Rayner, 2006*) there is a degree of consensus that we may make better policies and decisions if they are appropriately informed about what we know, and do not know, about the relevant natural and social systems. The studies point to some practical steps that can be taken to realise that aspiration, including:

- a stronger role for policy makers and their advisers in developing research questions and agendas;
- making it easier to find and access relevant experts and previous research and advice;
- strengthening interpretation capacity across the science-policy interface, systematically developing skills and providing an attractive career path; and
- developing the policy community as more discerning customers for science—providing more ‘policy pull’.

## 9. Concluding comments

The studies discussed in this paper point to similar concerns in the UK and other European countries about the use of science in environmental policy-making and regulation.

While people working at the interface of science and environmental policy-making in the UK may take some comfort from this – their problems are not unique or uniquely bad – less comfort may be taken from the inertia revealed by comparison with earlier studies. The situation was aptly summed up by the Government Chief Scientific Advisor, Sir David King, in his evidence to the [House of Commons Science and Technology Committee inquiry \(2006b\)](#): “I think we have moved a long way, but this is a bit of a tanker that needs turning to get a full understanding of what the strength of scientific knowledge can bring to the evidence based system.”

Guidelines on policy-making ([Cabinet Office, 1999](#)) and the use of science in policy-making ([Office of Science and Technology, 1997, 2000, 2005](#)) arguably do a good job in setting out an approach that is pragmatic and realistic whilst also reflecting the nuanced interplay of evidence and politics (described in [Jasanoff \(2003\)](#) and [Engels \(2005\)](#)). However, the findings of the studies conducted by ERFF reveal that practice has, on the whole, not yet caught up with the guidance.

#### REFERENCES

- Bielak, A., Campbell, A., Pope, S., Schaefer, K., Shaxson, L., 2008. From science communications to knowledge brokering: the shift from “science push” to “policy pull”. In: Cheng, D., Claessens, M., Gascoigne, T., Metcalfe, J., Schiele, B. (Eds.), *Communicating Science in Social Contexts: New Models, New Practices*. Springer, pp. 201–226.
- Boaz, A., Ashby, D., Young, K., 2002. Systematic reviews: what have they got to offer evidence based policy and practice? ESRC UK Centre for Evidence Based Policy and Practice: Working Paper 2.
- Boaz, A., Ashby, D., 2003. Fit for purpose? Assessing research quality for evidence based policy and practice. ESRC UK Centre for Evidence Based Policy and Practice: Working Paper 11.
- Bullock, H., Mountford, J., Stanley, R., 2001. *Better Policy-Making*. Cabinet Office, Centre for Management and Policy Studies, London.
- Cabinet Office, 1999. *Professional Policy-Making for the Twenty-First Century*. Strategic Policy-Making Team, Cabinet Office, London.
- Campbell, S., Benita, S., Coates, E., Davies, P., Penn, G., 2007. *Analysis for Policy: Evidence-based Policy in Practice*. Government Social Research Unit, HM Treasury.
- Chalmers, I., 2005. If evidence-informed policy works in practice, does it matter if it doesn't work in theory? *Evidence and Policy* 1 (2), 227–242.
- Clark, R., 2007. *Using Research to Inform Policy: the Role of Interpretation*. Final Report. Environment Research Funders Forum. <http://www.erff.org.uk/documents/20070302-interpret-study.pdf>.
- Commission on the Social Sciences, 2003. *Great expectations: the social sciences in Britain*. March 2003.
- Council for Science and Technology, 2005. *Policy through dialogue: informing policies based on science and technology*. Council for Science and Technology, March 2005.
- Defra, 2005. *Evidence and Innovation Strategy 2005–08*. Consultation document, October 2005.
- Defra Science Advisory Council, 2006. *End to end review of science into policy in Defra*. Department of Environment, Food and Rural Affairs, Paper SAC (06) 22.
- Delaney, A.E., Hastie, J.E., 2007. Lost in translation: differences in role identities between fisheries scientists and managers. *Ocean & Coastal Management* 50, 661–682.
- Dilling, L., 2007. Towards science in support of decision making: characterizing the supply of carbon cycle science. *Environmental Science & Policy* 10 (2007), 48–61.
- Engels, A., 2005. The science–policy interface. *The Integrated Assessment Journal* 5 (1), 7–26.
- Environment Agency, 2004. *Solving Environmental Problems Using Science: Science Strategy 2004 Onwards*.
- Environment Research Funders' Forum, 2007. *Strategic Analysis of UK Environmental Research Activity*. ERFF Report 04.
- European Commission, 2001. *European Governance: a white paper*. COM (2001) 428 final.
- European Commission, 2002a. *Science and Society Action Plan*.
- European Commission, 2002b. *Communication from the Commission on the collection and use of expertise by the Commission: principles and guidelines*. COM (2002) 713 final.
- Food Standards Agency, 2006. *Science Strategy 2005–2010*.
- Guston, D., 2001. Boundary organizations in environmental policy and science: an introduction. *Science, Technology and Human Values* 26 (4), 399–408.
- Haas, P., 2004. When does power listen to truth? A constructivist approach to the policy process. *Journal of European Public Policy* 11 (August), 569–592.
- Hammersley, M., 2005. Is the evidence-based practice movement doing more good than harm? Reflections on Iain Chalmers' case for research-based policy making and practice. *Evidence and Policy* 1 (1), 85–100.
- HM Government, 1999. *Modernising Government*. Presented to Parliament March 1999, Cm 4310.
- Holmes, J., 2005. *The Use of Science in Environmental Policy and Regulation: Baseline Review*. Environment Research Funders' Forum. <http://www.erff.org.uk/documents/20050600-baseline-review.pdf>.
- Holmes, J., Savgard, J., 2008. *Dissemination and implementation of environmental research*. Swedish Environmental Protection Agency Report 5681, February 2008. [http://www.skep-era.net/site/files/WP4\\_final%20report.pdf](http://www.skep-era.net/site/files/WP4_final%20report.pdf).
- Holmes, J., Lock, J., 2008. *Improving communication between fisheries managers and researchers*. MariFish ERA-NET Report D1.10. <http://www.marifish.net/publications/D1.10-Communication.pdf>.
- House of Commons Science and Technology Committee, 2006. *Research Council Support for Knowledge Transfer*. Third report of session 2005–06. HC 995-1.
- House of Commons Science and Technology Committee, 2006b. *Scientific advice, risk and evidence based policy making*. Seventh report of session 2005–06. HC900-1.
- House of Lords Select Committee on Science and Technology, 2000. *Science and Society*. Session 1999–2000, 3rd report, February 2000. HL paper 38.
- Irwin, A., 1995. *Citizen Science: A Study of People, Expertise and Sustainable Development*. Routledge, London.
- Jasanoff, S., 2003. Technologies of humility: citizen participation in governing science. *Minerva* 41, 223–244.
- Lövbrand, E., 2007. Pure science or policy involvement? Ambiguous boundary-work for Swedish carbon cycle science. *Environmental Science & Policy* 10, 39–47.
- Lorenzoni, I., Jones, M., Turnpenny, J., 2006. Climate change, human genetics, and post-normality in the UK. *Futures* 39 (1), 65–82.
- Marston, G., Watts, R., 2003. *Tampering with the evidence: a critical appraisal of evidence-based policy-making*. *The Drawing Board: An Australian Review of Public Affairs* 3 (3), 143–163.
- McNie, E.C., 2007. Reconciling the supply of scientific information with user demands: an analysis of the problem

- and review of the literature. *Environmental Science and Policy* 10, 17–38.
- National Audit Office, 2003. Getting the evidence: using research in policy making. Report by the Comptroller and Auditor General. HC 586-1 Session 2002-03.
- Nutley, S., 2003. Bridging the policy/research divide: reflections and lessons from the UK. Keynote paper presented at “Facing the Future: Engaging stakeholders and citizens in developing public policy”. National Institute of Governance Conference, Canberra, Australia 23/24 April 2003.
- Office of Science and Innovation, 2006. Science Review of the Department of Environment, Food and Rural Affairs.
- Office of Science and Technology, 1997. The Use of Scientific Advice in Policy Making. Office of Science and Technology, Department of Trade and Industry.
- Office of Science and Technology, 2000. Guidelines 2000: Scientific Advice and Policy Making.
- Office of Science and Technology, 2001. Scientific Advice and Policy Making. Report by the Chief Scientific Adviser, Office of Science and Technology, Department of Trade and Industry.
- Office of Science and Technology, 2005. Guidelines on Scientific Analysis in Policy Making, October 2005.
- Owens, S., 2005. Making a difference? Some perspectives on environmental research and policy. *Transactions of the Institute of British Geographers NS* 30 287–292 2005.
- Owens, S., Petts, J., Bulkeley, H., 2006. Boundary work: knowledge, policy and the urban environment. *Environment and Planning C: Government and Policy* 24 (5), 633–643.
- OXERA, 2000. Policy, risk and science: securing and using scientific advice. Health and Safety Executive, Contract Research Report 295/2000.
- Parliamentary Commissioner for the Environment, 2004. Missing links: connecting science with environmental policy. New Zealand, September 2004.
- Parsons, W., 2002. From muddling through to muddling up—evidence based policy making and the modernisation of British Government. *Public Policy and Administration* 17 (3), 43–60.
- Phillips, 2000. The BSE Inquiry: the report: volume 1. Findings and Conclusions.
- Royal Commission on Environmental Pollution, 1998. Setting environmental standards. 21st Report of the Royal Commission on Environmental Pollution, October 1998. Cm 4053.
- Pielke, A., 2007. *The Honest Broker*. Cambridge University Press.
- Pullin, A., Knight, T., 2001. Effectiveness in Conservation Practice: pointers from medicine and human health. *Conservation Biology* 15 (1), 50–54.
- Pullin, A., Stewart, G., 2006. Guidelines for systematic review in conservation and environmental management. *Conservation Biology* 20 (6), 1647–1656.
- Rayner, S., 2006. What drives environmental policy? *Global Environmental Change* 16 (2006), 4–6.
- Research Council Economic Impact Group, 2006. Increasing the economic impact of Research Councils—Advice to the Director General of Science and Innovation, Department of Trade and Industry, July 14, 2006.
- Royal Commission on Environmental Pollution, 1998. Setting Environmental Standards. Twenty-first report, Cm 4053, October 1998.
- Scott, A., Holmes, J., Steyn, G., Wickham, S., Murlis, J., 2005. Science Meets Policy in Europe. Defra.
- Scott, A., Holmes, J., Steyn, G., Wickham, S., Murlis, J., 2006. Science Meets Policy 2005: Next steps for an effective science-policy interface. Defra, February 2006.
- Shaxson, L., 2005. Is your evidence robust enough? Questions for policy makers and practitioners. *Evidence and Policy* 1 (1), 101–111.
- Solesbury, W., 2001. Evidence based policy: whence it came and where it's going. ESRC UK Centre for Evidence Based Policy and Practice: Working Paper 1, October 2001.
- Totlandsdal, A.I., Fudge, M., Sanderson, E.G., van Bree, L., Brunekreef, B., 2007. Strengthening the science-policy interface: experiences from a European Thematic Network on Air Pollution and Health (AIRNET). *Environmental Science & Policy* 10, 260–266.
- Walter, I., Nutley, S., Davies, H., 2003. Research Impact. A Cross-Sector review. Literature Review. Research Unit for Research Utilisation, University of St Andrews, January 2003.
- Wyatt, A., 2002. Evidence based policy making: the view from a centre. *Public Policy and Administration* 17 (3), 12–28.
- John Holmes** is a Senior Research Fellow at the University of Oxford, sponsored by the Environment Agency of England and Wales, and concerned with the use of science in environmental policy-making and regulation. The first 10 years of his career were spent in the management of R&D programmes on the assessment and development of clean energy technologies, working at the Coal Research Establishment of British Coal. In 1989 he became a Director of British Coal's Management Training and Development College. In 1992 he became Director for Science and then Technical and Engineering Director at UK Nirex Ltd., before leaving in 2000 to become Head of Science Programme for the Environment Agency.
- Rebecca Clark** was a senior researcher for the Environment Research Funders' Forum from 2006 to 2007. She investigated how staff in government departments and agencies request and obtain information from research and also contributed to a horizon-scanning study. Prior to that she worked as a senior post-doctoral researcher in the Department of International Development at the University of Oxford. She now works for Natural England (the views presented in this paper are those of the authors and do not necessarily represent the views of Natural England).