2.2. Knowledge in support of governing sustainability transitions

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The way governments and societal actors handle new knowledge and information is of major relevance for sustainability transitions (Loorbach 2010; Kemp, Loorbach & Rotmans, 2007). The objective of this chapter is to discuss the processes in which knowledge is used, not used or abused as a central component in environmental governance. It continues the discussion started in the previous chapter on the role of knowledge and learning in the dynamics of social-ecological systems, explains typologies of knowledge (e. g. scientific, practical and unwanted) and knowledge use, interactions between actors, and policy problems, explores the policy context of knowledge production and utilization, and introduces such concepts as advocacy coalition, agenda-building and barriers to agenda-building.

2.2.1. Conceptual and methodological questions

For several decades, policy scientists and sociologists have been struggling with the conceptualization of knowledge use in public policy. There have been quite some efforts to structure this issue in a manageable way, which have resulted in quite different frameworks for evaluation research. Notwithstanding all differences, we think it is fair to say that there is scientific consensus with respect to the following observation: Variables to be taken into account relate (1) to the type of knowledge, which may also include institutional factors such as culture and tradition with respect to academic disciplines and the institutionalization of academic research, (2) the institutional policy context, including values, practical knowledge, the policy process, characteristics of the policy subsystem including the interactions between knowledge providers and potential users and (3) different types of actual use.

Below we will bring some conceptual clarity with respect to both issues. The main purpose of this exercise is not so much to make a decisive claim with respect to the state-of-the-art in knowledge for policy research but to frame the complexity in such a way that it helps the environmental researcher to find a way in assessing the usefulness of different frameworks and methods.

2.2.2. Different types of knowledge

There are various classification systems for knowledge. These classifications may assist in assessing and, eventually, explaining as to whether and why certain knowledge is more relevant in a decision context than other.

Fundamental versus applied research. Although this distinction is quite common, there is no agreement among researchers about its usefulness. One important feature of applied research is that it is aimed to be used by policy-makers or other stakeholders. Therefore, the value context of applied research is probably more critical than for fundamental research. Knowledge from applied research may be more relevant for a specific decision context than knowledge from fundamental research. However, in both types the research quality is critical. Research quality is traditionally assessed using criteria such as reliability and validity. This is what Van de Vall (1987) has labelled the first quality parameter of applied research. The other parameters for assessing the quality of applied research are referred to as the 'strategic', and the 'feasibility' parameter. The strategic parameter relates to shared values between the producer and user of the knowledge, whereas the feasibility parameter relates to the issue as to whether policy advice can be implemented (Van de Vall, 1987). Dunn (1980) has tested several hypotheses on research quality in the eyes of the anticipated user, such as (i) the reliability of research findings, (ii) the validity of research findings, (iii) research using contextually grounded concepts, which the user may better relate to than formal social science concepts and (iv) the use of quantitative versus qualitative research methods. Only for reliability and validity, Dunn found a moderate to strong correlation with utilization.

Scientific knowledge versus practical knowledge. Researchers of knowledge use have become interested in the distinction between, on the one hand, expert, academic or scientific knowledge and, on the other, what has been labelled as tacit knowledge (Polanyi, 1958), theory in practice (Argyris & Schön, 1974), policy frame (Holzner & Marx, 1979), belief system (Lindblom & Cohen, 1979), theory in use (Zaltman, 1983) or policy theories (Leeuw,

1991). The relevance of this distinction is threefold. First, scientific studies suggest that potential users evaluate information from academic research within the perspective of their own knowledge and experience. Non-use of research can thus be explained by the fact that the knowledge provided does not fit in with the decision makers' own belief system. Factors that explain for the sharing of knowledge and trust of information among potential knowledge users are the information source, the way information is phrased as well as the novelty of the information (Cuppen, Hisschemöller & Midden, 2009). Second, academic knowledge is not necessarily better suited to local situations than practical knowledge (Schön, 1983). Each policy decision, how evidence based it may look, inevitably involves practical knowledge. For academic knowledge, it may take a while before it becomes embedded in actions. This is called knowledge creep (Weiss & Bucuvalas, 1980). Third, whereas scientific theories are written down in a more or less formalized way, theories in practice are (in part) implicit. They provide policies with a supporting argumentative framework, which includes insights from scientific reports as well as taken for granted assumptions (common sense knowledge). One well-known example of 'taken-for-granted' assumptions in environmental policy is that sustainable solutions are normally more expensive than unsustainable ones.

The dynamics of knowledge systems, boundary work and unwanted knowledge. Science is divided into different disciplines. It has been widely acknowledged that building bridges between disciplines is a key condition for increasing its usability in public policy. However, the disciplines themselves, with their specific conceptual and methodological frameworks, are among the primary *institutional* barriers that inhibit the sharing of knowledge among them or even among fields within a single discipline. In different countries there are different traditions with respect to the organization of knowledge production through academia and consultancy and knowledge use (e. g. Hisschemöller et al., 2009).

The institutionalisation of knowledge production in relation to its dissemination and use is referred to as ‘knowledge system’ (Holzner et al., 1987; Holzner & Marx, 1979; Machlup, 1980). Knowledge systems are specified in terms of mandating, producing,

structuring, storing, distributing and utilizing scientific and practical knowledge (cited in Hisschemöller et al., 2001a: 7, 8). The concept of knowledge system points our attention to the relationship between specific institutional arrangements within the sphere of knowledge production for policy and their impact on knowledge uptake and use.

The term widely used to describe the interactions between science and policy is 'boundary work' (Gieryn, 1995). Boundary work refers to the negotiation processes that result in establishing the boundaries between policy and science. However, boundary work also produces an area where the boundaries between the realms of science and policy become fluid, especially by developing joint policy-research agendas and so-called 'boundary objects' (e. g. Hisschemöller et al., 2001a, Turnhout et al., 2008). An example of a boundary object is the notion of ecological indicators. These are not based on mere scientific research but framed and defined in a process of negotiation and compromise within a policy-science network (Turnhout et al., 2007, 2008). Another example of a boundary object is the Trias Energetica for the Netherlands or the energy hierarchy in the UK (Hisschemöller & Sioziou, 2013). This concept prescribes a course of action for diminishing the use of fossil energy through, first, investing the maximum in energy savings, second, investing in renewables and third, if there is money left, investing in energy efficiency. In consequence, policies aimed at saving energy strongly focus on building insulation rather than on integrated concepts for creating energy neutral buildings. Hence, boundary objects bring some focus into both the research and policy orientation, but at the same time they reduce the opportunities for competition. Although a knowledge system allows for competition between knowledge claims (Dunn, 2001), it also marginalizes knowledge, not because it is bad science, but because it belongs to the category Machlup (1980) has referred to as unwanted knowledge.

Unwanted knowledge does not fit in with dominant interests or beliefs. An example of unwanted knowledge is low temperature heating as an alternative for current high temperature heating systems based on fossil fuels. In the Netherlands and elsewhere, the dominant idea is that greenhouse gas emission reductions in the built environment must be realized by firm insulation of buildings (trias energetica). Technologies that focus on low value heat in combination with heat and cold storage are still in the very margins of the

knowledge system related to climate neutral buildings (Hisschemöller & Cornelisse, 2008; Hisschemöller, 2016). An (in)famous example of government attempts to keep unwanted knowledge out of publicity is the evidence concerning BSE (Bovine spongiform encephalopathy, commonly known as mad cow disease) in the UK of the 1990s (Jasanoff, 2001). This case shows that disregarding scientific evidence may have serious consequences. The BSE scare in the 1990s UK led to huge societal unrest, mistrust in food safety and a paralysis on the side of British government.

What we learn is that critical knowledge in the margin of a knowledge system and unwanted for policy can nevertheless be very relevant in the long run. "*From the standpoint of communications theory and language, the information-content of a hypothesis tends to be negatively related to its relative frequency, or probability of occurrence. Hypotheses that are mentioned more frequently — those on which there is substantial consensus — have less probative value than rarely mentioned hypotheses, because highly probable or predictable hypotheses do not challenge accepted knowledge claims. The importance of challenging knowledge claims should be evident when we consider that the only process available for determining the plausibility of a knowledge claim, or for confirming or corroborating a scientific hypothesis, is one of testing and eliminating rival hypotheses*" (Dunn, 2001: 425, 426). One of the implications of this observation is that, next to usable knowledge, unwanted knowledge can also be considered 'usable ignorance', which can be detected by systematic research into rival hypothesis, often present in the margin of a knowledge system with stakeholders outside the dominant knowledge networks (Dunn, 1994).

What we can conclude so far is that utilization of knowledge for policy is very much dependent on research quality, but equally so on shared values among researchers and policy-makers. We, secondly, learn that the knowledge system itself imposes barriers on the production of useful research, e. g. if traditional cleavages between disciplines stand in the way of an integrated approach in policy research. Thirdly, we can conclude that, ironically, the most relevant research results often meet with the least acceptance among policy makers, as these results come from research that critically questions dominant knowledge claims. This also explains for the fact that it

normally takes quite a while, before new insights break through the barriers imposed by the dominant knowledge system.

Methodological implications. Here, we discuss some methodological implications from the findings so far. How can we, in a systematic way, map out practical knowledge and assumptions that relate to knowledge produced in specific knowledge systems? One possibility is to compare practical knowledge or 'policy theories' with scientific knowledge available. Scientific knowledge is used to the extent the policy theory is congruent with the scientific state of the art. The steps to be taken in this method are roughly as follows (Leeuw, 1991, 2003):

1) Articulate or 'surface' the assumptions underlying a specific policy. This can happen by document analysis and interviewing key-policy makers. This exercise results in the articulated policy theory, i. e. the set of assumptions that underlie the policy in question.

2) The policy theory must be presented as if it were a scientific theory, including hypotheses with respect to cause-effect relationships, the expected impacts of means (actions, interventions, instruments) to reach goals as well as the relationships between the different values at stake.

3) Evaluate the quality of the policy theory. The analyst looks into scientific work and checks for each of the Hypotheses under 2 as to whether they are congruent with the notions from science.

The idea of articulating assumptions is a basic methodological device (see also Mason & Mitroff, 1980).

If the quality of the underlying policy theory is evaluated with reference to the latest scientific insights, one may very well find an underutilization of scientific knowledge. Underutilization can relate to notions with respect to behaviour, such as the persistent ideas about the effectiveness of environmental subsidies, whereas in fact the impacts are limited. An example of comparing public policy assumptions with findings from scientific research is provided by the Dutch General Accounting Office (Algemene Rekenkamer, 2008) study on sustainable fisheries. The study evaluates EU and Dutch policy aimed at preservation of flatfish and marine ecosystems through quota and other instruments. It cites the EC in stating that many fish species are at a level below biological minimum, which is partly due to the fact that

the yearly restrictions for fisheries are lower than what has been advised by marine biologists. Total Allowable Catch (TAC) has been higher than what would be expected on the base of scientific advice. However, a complicating factor is that scientific advice by the International Council for the Exploration of the Sea (ICES) (biologists) uses a margin for uncertainty in the range of 30–40 %. Hence, it is concluded that, "*because of this large margin the scientific information does not provide a clear picture of the real conditions as regards commercial fish varieties and therefore provides a weak basis for policy*" (Algemene Rekenkamer, 2008: 40, 41).

An additional quality of this method is that, in evaluating policy effectiveness, it is also capable of identifying knowledge gaps. For example, in an evaluation of nature conservation policy, the Accounting Office found that policy instrumentation was fit to provide a gradual increase of natural areas, but also states that information on nature quality in these areas is only partially available, as research and monitoring are absent (Algemene Rekenkamer, 2006).

In short, we address two specific limitations related to this methodology. First, assumptions underlying public policy are not always easy to trace. Some of them are well explicated in policy papers, parliamentary records or by policy officials in personal interviews. However, some of them are implicit and hidden from first sight. There may be different causes for this. One cause may be that policy officials do not want to fully explain their policy goals or objectives — they may be secret. Yet, another cause, equally likely, is that policy officials are not aware of their assumptions. This is especially the case with so-called taken-for-granted assumptions that relate to common sense. An interview technique that may highlight this type of assumptions is to keep asking questions up to the point where the interviewee answers like: "*But isn't it common knowledge that…*", "*Don't we all know that…*". Another difficulty of tracing policy assumptions is that they may be contradictory. A difficulty with the articulation of policy assumptions is always that this activity is, in part, subjective. The product is the researcher's own understanding of what is being presented. One cannot avoid subjectivity, but one can only reduce its negative consequences by building the best argument for each case. This means that, in addition or instead of phrasing policy assumptions in terms of tentative hypotheses, one can use frameworks from argumentation analysis to present policy theories.

A second limitation is that this method relies very much on espoused scientific theories and findings. It does insufficiently into account the value of (tacit) personal and practical knowledge of policy-makers.

The limitations mentioned do not stand in the way of using the approach. An obvious advantage of this approach is that it enables government officials and other stakeholders to reflect upon the information provided and to agree or disagree with the findings. The technical complexity of the method is rather low and its use does not bring high costs.

2.2.3. Policy Context

We can think of quite some factors, linked to the policy context that may have an impact on use or non-use of knowledge in policy. Examples are (Dunn, 1980):

(1) the shorter the time span of problems, the greater the knowledge utilization,

(2) the more a policy issue involves an operational decision (rather than a strategic one), the greater the knowledge utilization,

(3) knowledge will be used more in private organizations with formal profit incentives than in public organizations, which lack these incentives,

(4) the presence of outside evaluators will enhance knowledge use rather than evaluators from inside,

(5) knowledge produced by change agents formally affiliated with the sponsoring organization will be utilized more than knowledge produced by unaffiliated change agents,

(6) knowledge utilization is positively influenced the more influence all stakeholders including the knowledge providers exercise during all stages of the policy process,

(7) the more the (social) scientists use a diffusion style that encourages feed-back, the greater knowledge utilization, and

(8) the more the products are stored in personal verbal reports rather than written documents, the greater the utilization.

By that time (end 1970s), positive correlations were only found for the hypotheses 3, 5, 6 and 8. H3 may imply that public agencies lack an incentive system for enhancing knowledge use or, to put it differently, that the incentive to use specific knowledge may

be outweighed by stronger incentives to maintain the status quo. H5 suggests that knowledge is more likely to be used when the research agency or researchers are operating within or very close to the organization that commissions the research. We already referred to factors that explain for the sharing of knowledge and trust of information among potential knowledge users. The information source must be trusted, which is more likely when the source is part of the (immediate network of the) agency which commissions the research. If this information source is part of the immediate network of the knowledge user, then (s)he is more likely to phrase the knowledge in a way understandable for the customer. The novelty of information can be a problem, but the more a researcher is part of the customer's immediate network; the more unlikely it is that this researcher will drop information completely new to the user. As regards H6, the more the researchers are part of the network of the commissioning agency; the more likely they are to enact influence during all stages of the policy process. And this would also imply that the message of the research will not only be reported in a document, but will be stored in personal verbal reports on the side of the policy-makers who commissioned the research, as is hypothesized under H8.

There is evidence from theory and practice that policy agencies have a preference for working with research agencies they are familiar with for quite some time. Theoretical evidence is provided by economic theories of policy-making and bureaucracy, as developed by Antony Downs in his famous *Inside Burocracy* (1967). Being rational in their behaviour, bureaus and bureaucrats tend to conservatism and avoid risks, both in their personal interest and in the interest of the bureau. New insights provide risks of all kinds, so there is a great tendency not to follow up on these. As Downs put it: "*Officials who exhibit a great deal of initiative and innovative behavior are more likely to encounter frustration and failure in achieving their goals than those who seek merely to survive and retain the status quo.*" (p. 267). Rich (1991) argues that the use of research findings is largely dependent on the specific interests of the policy agency. Findings from empirical studies confirm the conservatism of policy agencies as it comes to effective policies for enhancing sustainability. A study into the lobbies of the renewable energy sector in Germany shows that policy-makers express a preference to have longstanding relationship with lobbyists rather than being lobbied by

strangers on an incidental basis (Sühlsen & Hisschemöller, 2014). The implication from this is that larger companies have much better access to policy-makers in Germany, but probably in general, than smaller innovative companies who cannot afford to hire lobbyists on a daily basis. It also implies that the knowledge provided by vested interests is more likely to be accepted in policy-making circles, as this knowledge is cited more frequently and on which there is substantial consensus. Knowledge providing agencies, like sustainability consultants and universities, which are dependent on grants and subsidies for their work, tend to adapt their policy advice to the mainstream in the knowledge system, as they run the risks of missing contracts and, because of this, losing jobs.

Hence, the main challenge for independent environmental researchers is to get access to anticipated clients of their research findings and enter with them into a dialogue during the different stages of the policy process in order to convince them of the relevance of their research. Below we discuss three analytical models designed to systematically research into the utilization of knowledge and the way the policy context affects knowledge utilization. These models are (1) the Advocacy Coalition Framework (Fig. 2.3), (2) the agenda building approach and (3) problem structuring.

The *Advocacy Coalition Framework* (ACF) (Sabatier & Jenkins-Smith, 1993, 1999) underlies the observation that it takes a long period, a decade or more, for new knowledge to have an impact on policy-making. Policy change is a function of three sets of processes (Hisschemöller et al., 2009: 285):

1. The interaction of competing advocacy coalitions within a policy subsystem, e. g. the subsystem environmental policy. An advocacy coalition consists of actors from a variety of positions and institutions (elected and agency officials, interest group leaders, researchers, etc.) who share a particular belief system, and who show a nontrivial degree of parallel action over time. Coalition actors seek to translate their beliefs into public policies throughout the governmental system. The concept of an advocacy coalition assumes that it is shared beliefs that provide the principal 'glue' of politics.

2. Changes external to the subsystem in socio-economic conditions, public opinion, system-wide governing coalitions, and decisions from other policy subsystems.

3. The effects of changes in relatively stable system parameters: the basic attributes of the problem area, the basic distribution of natural resources, fundamental socio-cultural values and social structure, and the basic constitutional structure. For both the cause and solution of environmental issues, these parameters may be critical.
The ACF is visualized in Fig. 2.3.

As a method for policy analysis, the ACF focuses on articulating the policy belief systems of (competing) advocacy coalitions. In order to facilitate this analytical activity, the ACF proposes that the belief system of an advocacy coalition is structured into three categories, arranged in order of decreasing resistance to change:

- a Deep Core of fundamental normative and ontological axioms that define an actor's underlying personal philosophy;
- a Near Policy Core of basic strategies and policy positions for achieving deep core beliefs in the policy area or subsystem in question;
- a set of Secondary Aspects comprising a multitude of instrumental decisions and information searches necessary to implement the policy core in the specific policy area.

Policy change can be brought about by pressures external to the policy subsystem — environmental disasters or financial crises are examples of such pressures that may lead to policy change in the environmental subsystem. Yet, there is also the possibility of learning. The ACF distinguishes two types of policy-oriented learning: *within* a coalition's belief system, and *across* the belief systems of different coalitions. The first type of learning means that members of an advocacy coalition are seeking to improve their understanding of variable states and causal relationships consistent with their policy core ('puzzle-solving'). The second type of learning refers to a productive analytical debate between members of different advocacy coalitions. One or more coalitions are led to alter policy core aspects of their belief system (or at least very important secondary aspects) as a result of an observed dialogue rather than a change in external conditions. The ACF claims that learning across coalitions benefits from a moderate level of conflict, an issue that is analytically tractable (i. e. it has widely accepted theories and quantitative indicators), and the presence of a professionalized forum in which experts from competing coalitions must justify their claims. Experts may perform as knowledge brokers in order to promote political settlement.

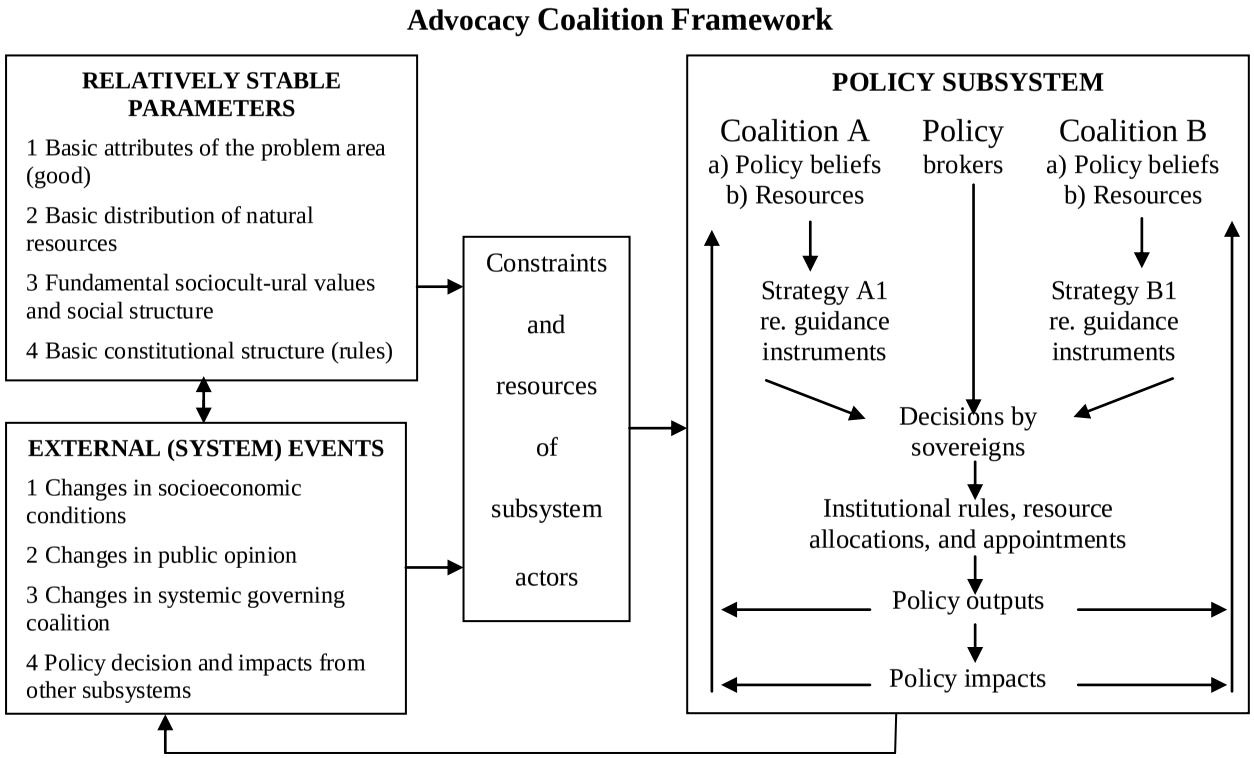

Fig. 2.3. The advocacy coalition framework. Source: Sabatier, 1998

The ACF has been used in numerous studies on environmental policy-making around the world. An example is a study into Poland's environmental policy during the transition from a state based to a market economy and from dictatorship to democracy (Andersson, 1999). In this study, advocacy coalitions were analyzed during the 1980s, before, and during the 1990s, after the transition. Next to national policy the study concentrates on sectoral environmental issues, i.e. air protection and salination water caused by mining. Andersson found quite some learning within and across advocacy coalitions in the air protection case. A special case was provided by research and debate about new environmental policy instruments, such as emission trading. Where the hard coal sector was concerned, Andersson found almost no interaction with the environmental sector and almost no learning. The hard coal sector was — and probably still is — considered as vital for the national economy, which has prevented necessary environmental measures from being taken.

Agenda building. A different approach in the analysis of (environmental) policy-making is political agenda building (Cobb & Elder, 1983). This approach was developed in the critical tradition in American political science during the 1970s. It is based on the work of the American political scientists Schattschneider (1960) and Bachrach and Baratz (1962). Central theme in Schattschneider's work is the observation that *"(a)ll forms of political organization have a bias in favor of the exploitation of some kinds of conflict and the suppression of others because organization is the mobilization of bias. Some issues are organized into politics while others are organized out."* (Schattschneider, 1960: 71). In line with this observation, Bachrach and Baratz (1962) conceptualized the notion that power has two faces. On the forefront, we witness political struggles about specific laws, regulations, measures and other policy interventions. Here we witness the power of winning coalitions in majority votes or compromise. Yet, at the background, we may witness a more hidden form of power with respect to the kind of problems that are allowed access to the political agenda and which issues are not. This is the power to decide on the framing of policy problems and thereby on the range of policy alternatives taken into consideration; in Schattschneider's expression this is "the supreme instrument of power" (1960: 66). This face of power has everything to do with the information and knowledge policy-makers

want or do not want to consider. For the situation where actors ask to take specific information into account, and where this information is nonetheless disregarded in the decision-process, Bachrach and Baratz invented the notion of 'non-decision'.

For the agenda building approach, it is of critical importance to not only look at the attempts of actors involved in the decision-making process to exercise power and influence in shaping decisions, but also, and even more, to look at the behaviour of actors who try to get involved, but who do not or only partially succeed. Where (non)utilization of knowledge is concerned, it is of critical importance to analyze how policy problems are framed and how, in consequence, specific information and knowledge is denied access to the political agenda and why.

The policy process has traditionally been divided into stages such as agenda setting — policy formulation — policy adoption — policy implementation — policy assessment (Dunn, 1994: 17; also Lindblom, 1980: 3). From an environmental management perspective, Winsemius (1989) distinguishes between problem recognition — policy formulation — policy action — self-regulation. Winsemius makes clear that policy in the various stages of problem recognition and solving requires different kinds of knowledge. In the first stages, where the problem is found to be relevant and strategic choices are made, there is a need for as much knowledge as possible. Competing scenarios and trajectories must be explored in order to find out: Do we have a problem, how big is it and are we going to do something about it? In the later stages, the knowledge required is focused on effectiveness and efficiency with respect to regulation and control. This management scheme implicitly recognizes one of the major problems associated with knowledge uptake in (environmental) policy. Once strategic political decisions have been made and specific policies are implemented, it is quite inconvenient to be confronted with new insights that shed a different light on the policy problem and the political interventions required. Knowledge that may be seriously considered at an ‘early’ stage, maybe rejected as unwanted knowledge in a later stage.

For this section, we propose an analytical model distinguishing five stages (Fig. 2.4). We thereby focus on the situation, very common in the field of environmental policy, that environmental problems are first discovered outside the realm of policy-making, e. g. by

environmental researchers, NGOs or citizens, who then try to bring these problems to the political agenda. First stage is raising a concern, for example, when some people get the idea that air or soil could be polluted. Second stage is that a person or group express a demand, for example: Do something about it! Or, we need independent information! In the third stage, the initial concern is transformed into a public issue. At this stage, the problem has made it to the public agenda. There will be media attention. Other organizations than the initial persons will get involved. The involvement of new actors, like (national) environmental NGOs or research agencies, may imply that the framing of the initial problem will be modified, which could either help or prevent the problem from reaching political agenda status. If successful, the issue will become a formal decision item on the political agenda. Eventually, a decision will be taken. It must be realized, that not each stage must be visible in every policy case. It happens that one or more stages overlap or are skipped. A demand can be directly transformed into a decision item or can become a public issue at the same time. It must also be realized, that the model proposed here can also be used to study policy implementation, because implementation also implies decisions and may lead to modifications of the initial problem. Critical in the model is the notion of barriers that may prevent information to pass from one analytical stage to another.

Over time, researchers have pointed to different types of barriers in the agenda building process. The major challenge for persons or groups to successfully bring a new message to the public or policy agenda is to be trustworthy and credible. An even bigger challenge is to keep attention for an issue over a longer period of time. According to Cobb and Elder (1983), barriers can either relate to the credibility of problem content or to credibility of the actors putting it forward. Strategies or mechanisms that affect the transition of a problem from one stage to another can be either direct or indirect. Examples are:

- *Direct issue (contents) oriented*. Concerns are completely unjustified, information provided is false. In today's terminology, we would say there is a spreads of fake news. Examples may include: "The idea of sea-level rise because of global warming cannot be true. When ice in the polar seas turns into water, the global sea level will remain equal." Or: "Long-term assessments do not provide any empirical evidence of global warming."

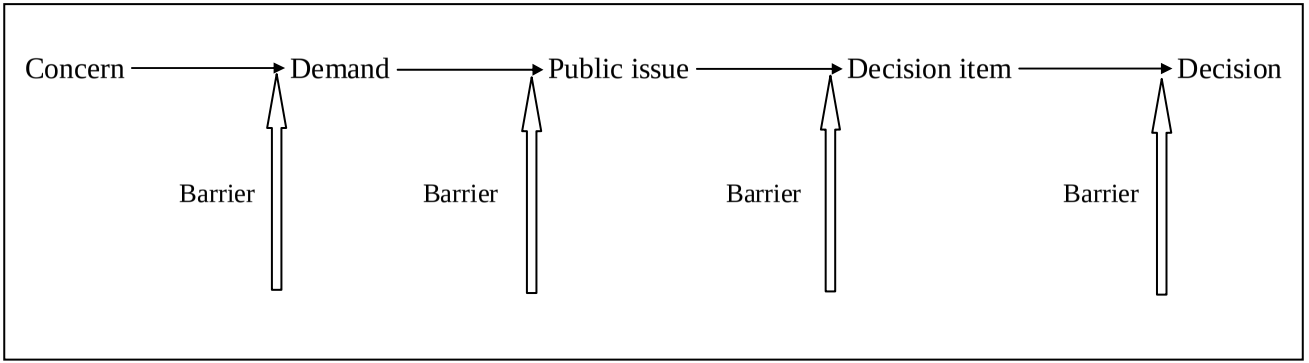

Fig. 2.4. An outside initiative model of political agenda building. Based on Hommes, Van der Heijden and Kok, 1986: 262

- Indirect issue oriented. Here, the alleged problem is not rejected, but all kinds of difficulties are raised to prevent taking action. Examples include: "There may be some truth in the theory on global warming. However, the problem is extremely complex and needs further investigation before taking action." Or: "Unfortunately, there is lack of funding at the moment", as other issues are competing for priority. This example is cited by Downs (1972), who points out that is a challenge to put an environmental problem on the policy agenda, but even more difficult to keep the attention. After some time, people will get bored with the issue and attention will shift to other pressing problems.
- Direct actor oriented. Here the strategy to prevent agenda status for a problem is targeted at the person(s) or group putting the issue forward. For example, the industrial in the US tried to manipulate public opinion in order to prevent measures for protecting the ozone layer, stating that the scientists who claim the depletion of the ozone layer have been bought by the Soviets in order to destabilize the US free economic system (Dotto & Schiff, 1978).
- Indirect actor oriented. Here, persons or groups who try to push a problem towards the policy agenda are involved in the policy process, but in such a way that they may become coresponsible for delay: "We invite critics to take part in a broad research commission".
- It is important to note that also environmental NGOs have their specific interests that may contribute to undermining environmental issues. In the Netherlands during the 1990s, some important environmental NGOs have been in doubt as to whether they give priority to promoting the climate change issue. Their reluctance can be explained by their concern, that climate change would revitalize the nuclear option, which was just removed from the policy agenda because of Tsjernobyl (Dinkelman, 1995). When different actors take ownership of a problem, they add meaning to it or shape its connotations. A societal organization, such as an environmental NGO, a trade union or an academic institution, has its specific institutional bias including its ideology, belief system, working routines, coalitions with others, and history. This may, on the one hand, enable the transition of a problem to the national political agenda. However, on the other hand, it may change the initial meaning of the problem and so even become a barrier for its full consideration.

The barriers described so far imply more or less conscious strategies employed by actors. However, these can be added to the barriers cited in section 2.2.2. These are more of an institutional na-

ture; they relate to longstanding ways of doing things, the way our political and knowledge institutions have been shaped over time and the culture that policy (sub)systems have developed. Institutional barriers are much harder recognize and to tackle than actor strategies alone. We can expect to always find combinations of actor strategies and institutional barriers. These all have an immediate impact on the dissemination and uptake of information, to the linking of facts and values and, simultaneously, to the exclusion of competing knowledge claims and information from political consideration.

Problem structuring

Policy-making and the role of experts therein can also be understood by pointing to different types of rationality. Diesing's (1962) typology of rationality, differentiating between technical, economic, legal, social and political rationality how different lines of reasoning, all embedded in decision-making, provide competing contexts for the contents of policies and policy problems, as well as the specific role envisioned for experts. Diesing's work is shows that there is a relationship between problem contents and policy process (see also the typologies developed by Thompson and Tuden (1959) and Lowi (1972)). The relationship between problem content and policy process is referred to as problem structure (Hisschemöller & Hoppe, 2001; Hisschemöller, 2005). In this approach, a social or policy problem is defined as a gap between (a) certain value(s) and an observed situation (e. g. Dunn, 1994). The relation between values and facts is what distinguishes a problem from a phenomenon. A problem is considered a social construct: what is a problem for one person is not necessarily a problem for another person (Hisschemöller & Hoppe, 2001).

For identifying problems with a different structure, two basic questions are addressed:

1. Is there consensus on what knowledge (including skills and methods) is relevant for addressing the policy problem? The word knowledge here refers to both academic and practical knowledge.
2. Is there consensus on the values relevant for the problem at stake?

Fig. 2.5 shows four different *types of policy problems* according to their *structure*, the relationship between contents and process. It should be noticed that the distinction between knowledge and values, the X and Y axes of Fig. 2.5, is ideal-typical. In actual poli-

cies knowledge and values always appear together, articulated in a specific way (Cell A–D). This typology highlights in a simplified fashion the biases that can be observed in policy processes and how these shape and limit the possibilities for scientists and other knowledge providers to make a contribution to policy.

Before discussing the different problem types in more detail, we need to point out one important element in the problem structuring approach. Methods appropriate for addressing one kind of problem are not appropriate for addressing problems with another structure. Each problem type fits a specific problem solving approach.

Consensus on relevant values? / **Consensus on relevant knowledge?**	***NO***	***YES***
NO	**UNSTRUCTURED PROBLEM** Policy as learning Science as problem finding **A**	**MODERATELY STRUCTURED PROBLEM** Policy as negotiation Science as advocate **B**
YES	**C** **BADLY STRUCTURED PROBLEM** Policy as accommodation Science as mediator	**D** **STRUCTURED PROBLEM** Policy as ruling Science as problem solver

Fig. 2.5. Four types of policy problems and policy styles and their bearing on the role of science in public policy.
Source: Hisschemöller et al. (2001b)

Dunn refers here to the principle of methodological congruence: "The appropriateness of a particular type of method is a function of its congruence with the type of problem under investigation." (Dunn, 1988: 724). Structured problems are for example successfully addressed by quantitative methods, such as cost-benefit analysis or risk analysis. In contrast, unstructured problems require methods for problem finding or structuring in order to assess the complex problem situation and develop a vision on goals and means for policy. Very basic in problem structuring is that people involved talk about the problem and share ideas and information. If a problem is addressed with a (research) method that does not fit in with the problem type, then the policy-maker or researcher is likely to overlook relevant information. As Dunn phrases it: "Yet critical elements of a problem situation may lie outside the boundaries of an individual's construction system; what is unrecognized and unknown cannot be understood or anticipated." (Dunn, 1988: 723). We must add to this that what is true for individuals is also true for institutions. In consequence, policy-makers may find correct solution however for the 'wrong' problem. This phenomenon is referred to as Type III error (Dunn, 1994).

Below we will discuss the four problem types, showing what policy process is considered adequate for addressing environmental problems of this type, as well as showing what happens if the 'wrong' problem is addressed.

Policy as Rule (Fig. 2.5, Cell D). Policy as Rule applies to structured problems, i.e. problems characterised by consensus on both relevant knowledge and values. In consensus situations, the problems are usually considered technical. Persons rely on expert judgment. Experts are known and trusted, as there is also consensus on who is an expert and who is not. In case a policy problem is considered to be structured, policy-makers rely on scientific and technical experts. This would not always imply that experts get formal decision-making status. Traditional boundaries between policy and expert advice are kept intact, science advises policy. The policy process, congruent with this problem type I refer to as Ruling. In policy as Ruling, scientific advice is *de facto* binding for policy decisions. Many routine policy decisions are based binding expert advice. We may think of safety precautions for buildings and the important role

of for example the local fire departments in formal decisions concerning construction safety. Management by Ruling works well for the great amount of small, routine decisions and if conflicts arise, there are standard procedures to deal with them.

The decision maker in this type of policy is usually one monolithic actor. The advisors are part of a closed policy-science network, which is characterized by a rather straightforward and commonly accepted division of tasks, competences and responsibilities. The role of science is problem solving. Policy as Rule supposes expert consensus.

It may happen that consensus is not real, but imposed on affected citizens by government. Opposition is not recognized as legitimate in policy as Rule. Resistance to policies is normally considered to be based on uninformed, emotional response (fake news). In turn, resistance is based on a lack of trust, often because of secrecy on the side of decision-makers. An interesting case arises when scientists get divided amongst themselves, as has been the case in controversies around nuclear power or genetic modification. Critics maybe accused to be driven by political rather than by scientific motives. Historic experience with the nuclear energy debate and the debate on GMOs, illustrates that it is far from easy to accept information put forward by critics from the science community as science. Once this happens, the problem is no longer treated as structured and shifts to a more pluralist policy setting.

Policy as Negotiation (Fig. 2.5, Cell B). The moderately structured problem is characterised by consensus on the values at stake, i.e. some public good that needs protection, but uncertainty and conflict as regards the best way to realise common ends. Different interests are at stake. In contrast to the structured problem, these differences are considered legitimate. Moderately problems are often issues of distribution. The conflict is who gets what piece of the cake? The adversarial process for addressing problems of this type is called Negotiation. Even if actors do not really believe in the consensus on the goal, such as addressing climate change or reduction of fish-stocks, they have to play the game according to its rules in order to maximise gain and minimise losses. In this policy type, research-and-analysis becomes an intellectual ammunition in the pluralist

group struggle. Processes of partisan mutual adjustment (Lindblom, 1965) work like a selection device for scientific arguments in support of previously determined policy stands. Each and every interest will mobilise its own science-based expertise to bolster its case. In this system, policy analysts are like lawyers, and their business is advocacy (Hisschemöller et al., 2001a). In the adversarial model, separate actors defend or strengthen their respective positions in the short run, while in the long run policy oriented learning may result (Sabatier & Jenkins-Smith, 1993). Needless to say, the conflict of interests seriously limits the opportunities for scientists to take a nuanced position, which may provide a 'third way' out of the conflict.

Jasanoff (2001) has convincingly argued that, what she refers to as an over politicization will hamper a proper use of scientific research. In case of over politicization, there will be deadlock rather than a constructive dialogue. Deadlock in fact happens when different stakeholders disagree not only on means, such as the amount of money to be allocated to what or the most effective policy instrument to be deployed, but on the policy goal or the values at stake. Common examples are health risks or external safety in case of polluting industries or airports, destruction of ecological values in case of the construction of highways or the planning of wind turbines.

Policy as Accommodation (Fig. 2.5, Cell C). The badly structured problem can be best understood as a conflict between irreconcilable values, a dilemma without a solution perspective. The best one can hope for is a compromise, which keeps the main conflicting parties on board. The type of interaction that matches with the search for compromise is situated somewhere in the middle between the technocratic, knowledge driven concept of Ruling and the politicized, adhocracy practices of Negotiation.

The strategy for working out a compromise is characterised by depoliticization of the value conflict, in other words by transforming the social and political issue into a technical one. The first step in this direction is to move away from a specific problem situation to a problem at a more general level, abstract and long-term. Politics and research concentrate on the invention and internalisation of concepts, such as 'sustainability' or 'precautionary principle' rather than rather than specific interventions. The politics of compromise are often symbolic but may en-

hance a process of policy learning, which may in the end result in specific interventions. Science in a mediatory role may flourish under this kind of policy; there is a need for multidisciplinary research and, to support the process of accommodation, interaction between scientists and policy makers. But still, the borders between science and policy are intact, as well as most of the disciplinary boundaries. In order to make the mediation between conflicting policy views succeed, scientific consensus is a must. This type of policy-science interaction can frequently be seen in national environmental policy, especially in countries with a strong consensus tradition. But it can be observed even more clearly at the level of international environmental regimes that need to accommodate states with divergent conceptions of their national interests. International relations scholars share the view that scientific consensus, or the existence of so-called epistemic communities (Haas, 1991) is a vital condition for the success of any environmental regime. The Intergovernmental Panel on Climate Change (IPCC) is frequently cited as a successful example.

Policy as Learning (Fig. 2.5, Cell A). Situations where there is uncertainty about what knowledge is relevant as well as dissent on the relevant values at stake are characterised by the unstructured nature of the underlying problem. Once this situation has been recognised, it may be possible to engage in a process of problem structuring, i.e. to identify, confront, compare and, where possible, integrate different views (Hisschemöller & Hoppe, 2001). The policy process called Learning supposes that parties reconsider their (vested) interests, which makes learning both a cognitive and an emotional experience. What policy learning produces, is a new vision on the policy problem, goals and alternatives. It implies dialogue and co-production with respect to concrete problems, e. g. at a local or regional scale (Botts et al., 2001). Science has traditionally played a significant role in the signalling and agenda setting of environmental problems. However, the more complex these problems are, the greater the need for scientists to work in an interdisciplinary manner, which implies the identification, confrontation, and where possible integration of different scientific perspectives. The boundaries between science and practical knowledge get diffuse and may even become obsolete, when practitioners and experts have valuable insights

to offer. Therefore, experts are bound to cooperate in their very core business of knowledge production with non-experts or, to put it differently, experts in other fields. This requires specific qualities and may cost time. The difficulty with unstructured problems is that policy-makers usually try to avoid them, because they are so hard to manage and the outcome of the policy is far from certain.

Using this problem typology, Hisschemöller et al. (2001b) found from a comparative analysis of seven case studies of Dutch environmental policy making, the following barriers for knowledge dissemination and use:

1) knowledge from 'other' parties is disregarded,
2) there is a separation between knowledge needed for problem recognition and for problem solving,
3) certain academic disciplines (e. g. economics) are favoured over others; ethical issues get little attention in environmental research,
4) information on large scale level is preferred over information on small scale,
5) expert knowledge is favoured over lay knowledge.

These mechanisms in particular hamper the capacity of knowledge systems for environmental policy to explore and integrate competing knowledge claims.

Turnhout, Hisschemöller, and Eijsackers (2007, 2008) used the typology to analyse Dutch nature conservation policy, especially the development and use of ecological indicators. These and other studies illustrate the policy processes and the expert roles described here. They confirm that problem structure restricts the freedom of action for both knowledge providers and potential users. Policy-making may shift over time between Negotiation and Compromise in particular.

The most important lesson from problem structuring is probably that there are so many institutional barriers in both policy and knowledge systems that hinder learning among policy-makers, stakeholders and scientists though an open dialogue on conflicting perspectives. Policy-makers have a general inclination to be in control. Hence, they have a preference for more structured problems and dislike unstructured ones. They are normally unaware of mechanisms that exclude competing visions and knowledge claims from the policy agenda.

2.2.4. Types of actual knowledge use

The extent or degree to which knowledge is actually used in policy-making depends on how the concept 'use' is defined (Dunn, 1983; Rich, 1997). Dunn (1983: 121) states that "the variability of competing conceptions seems virtually endless." First, the definition must clarify as to whether the use is researched at the level of individuals or (a) collective(s). For example: could we say that 'enlightment' is to be reserved for individual decision-makers or for agencies, advocacy coalitions or even entire policy subsystems? Second, the definition must specify the expected effect of use. On this dimension two types of use can be distinguished, conceptual and instrumental use. Conceptual use relates to research influencing policy discourse, especially the phrasing of problems and interventions, whereas the latter relates to research influencing actual behaviour (changes in government actions). Third, one must consider the scope of use in terms of generality or specificity. Are we looking into the use of knowledge related to a policy instrument or a management concept in general or into the use of knowledge related to a specific program?

Most well-known are conceptual use, instrumental use and enlightment. Other concepts for classifying knowledge use are symbolic use, strategic use and abuse. We can link these distinctions to the different types of policy processes described above.

Slightly different from types of use is classifying the functions that knowledge may have in policy. Weiss and Bucovalas (1980) distinguish functions, or purposes' of knowledge use for the different stages in the political agenda process, such as (i) raising an issue, (ii) formulating new policies and programs, (iii) evaluating alternatives, (iv) improving existing programs, (v) mobilizing support, (vi) changing ways of thinking or (vii) planning new research.

In studying knowledge utilization in environmental policy, it is critical that the researcher in advance reflects on how (s)he operationalizes different notions of knowledge use.

2.2.5. Summary and conclusions

Sustainability transitions are long-term processes of systemic change, featured by the adoption of new ideas, knowledge and values together with the emergence of new actors, who become part of new regimes. This chapter discussed what we know about how knowledge becomes disseminated and eventually used by policy-makers and other societal actors. This chapter thereby focused on three critical aspects. First, we discussed different types of knowledge — including knowledge fundamental or applied science, and practical knowledge among policy stakeholders — and the relevance of knowledge systems — including the policy-science interface and boundary work. Second, we focused on the opportunities and constraints for knowledge utilization provided by policy contexts. We discussed three approaches from the policy sciences that point to specific issues related to the uptake of new knowledge, i.e. the Advocacy Coalition Framework, Agenda Building and Problem Structuring. Third, the chapter pointed to the difficulties we encounter in defining the notion of knowledge use.

The main conclusion from this chapter is that in studying knowledge utilization, we have to look into the short-term impact of knowledge but also the impact on the long term, knowledge use in different ways but also abuse, knowledge that is asked for by decision-makers but also unwanted knowledge, knowledge on the policy agenda and disregarded knowledge, as well as the biases that mould and shape information contents during policy processes over a longer period of time.

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