Topic D
Retrievability: A Spectrum of Views

Radioactive Waste Disposal: Taking Societal Views Into Account

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Radioactive waste management and the safe disposal of nuclear waste are not purely scientific or technical problems. Because of different possible conceptualizations of risks, and the inevitable involvement of (ethical) values, radioactive waste management and the question of what are suitable criteria for the acceptability of these risks are societal problems. One immediate implication is that societal groups may have different views on the issue. How can a decision maker take various and often diverging views into account?

The Dutch government, in preparing its position on the question of using deep geological (rock salt) formations for the disposal of radioactive and toxic chemical waste, has organized a public consultation procedure on this issue.\(^1\) It has invited four organizations to give, in a (closed) seminar, their view on the matter. In addition a nation-wide open consultation was organized, inviting, via national and regional newspapers, people to give their arguments pro or contra.

The Centre for Studies of Science Technology and Society (University of Twente) was subsequently asked to analyze these views and arguments.

In this paper the methodological approach of argumentation patterns and argumentation scenarios, and the main results will be presented. It is important to emphasize that such an approach differs from usual policy analysis in that it does not identify and evaluate policy options, but elucidates the argumentative structures in the set of position statements and arguments. Thus, the analysis does not privilege one option or argument above another. Rather, it opens up options for political decision making.

1. Background

The aim of the two consultation procedures was to get a better picture of the arguments that played a role in the debate on disposal of highly toxic waste in deep underground. It should emphasized that the procedures were not intended to be a referendum, so there is no point in counting the numbers of proponents and opponents to certain arguments. Our evaluation of the outcomes of the consultation procedures is to analyze the structure of the argumentation, independent from the question how often particular arguments occur.

In our analysis, and in the evaluation of argumentation, robustness is the key concept. In doing so, we depart from the usual approach (which is indeed applicable in a number of cases), where points of view and positions taken are assessed in terms of the correctness and relevance of the arguments on which the position is based. Whether a position is tenable then depends on the correctness of the arguments. If an argument turns out to be incorrect, another argument supporting the position must be given, or the position must be given up, or at least modified. In this type of discussion, the result will be an evaluation of arguments as correct or incorrect, and a distinction between tenable and untenable positions.

The discussion about acceptability of deep underground disposal of waste differs from such discussions on two points, and this has created problems in reaching acceptable conclusions. First, the participants in the discussion cannot agree on which arguments are correct, and which are not. The results of scientific research are not decisive, either, and become subject of discussion themselves. Second, the relevance of the various considerations cannot be ranked univocally: should retrievability be the dominant consideration, or safety, or the interests of future generations?

Even in cases where there is no consensus about correctness and relevance of arguments, discussion can be productive if it leads to articulation of the foci in debate. Foci in a discussion are the key points of departure and central considerations, of which the importance is recognized by all participants. A further result of discussion can be clarification: which arguments are widely accepted, and which are (hotly) debated; what are the links between certain arguments and certain positions.

There will still be no assurance of the correctness and relevance of arguments, but their robustness can now be assessed. Robustness is a pragmatic concept: arguments are robust if they can be supported without too much effort, through accepted principles, widely recognized policy, accepted results of research, agreed goals, or (other) robust arguments. Thus, an argument is robust if it can be defended when challenged. When such a defense is offered, it will lead to a further articulation of the argumentation. The process of discussion will not necessarily lead to consensus, but it will provide elaboration of argumentation which then allows assessment of further action, like the desirability of further research, the usefulness of further discussion, and/or the feasibility of reaching decisions. Robustness, thus, is characterized by (1) consolidation, at least a working agreement on how to handle differences, and (2) articulation of the network of arguments, views, interests etc. that lies behind the claim. The second characteristic is necessary, otherwise the claim would collapse at the first attack, or, like a fashion, survive only as long as the circumstances were favourable.

It is this conceptualization of the discussion that allows us to analyze and evaluate the arguments of the participants in the consultation procedures. Analysis and evaluation do not focus on the substance of the arguments as such, but on the coherence between the several arguments and with the subsequent positions.

The contributions of the participants in the seminar were well-articulated position statements, linked to a few key arguments. The contributions to the open consultation procedure varied from documents of several pages to postcards; from individual argumentation to preprinted sheets that had only to be signed; from positions supported by one argument (or none at all) to extensive argumentations, taking a multitude of points of departure, considerations, and arguments into account.

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2 The agreed upon summaries are available in Dutch.

3 77 separate arguments were distinguished, clustered under seven headings: future generations and retrievability (11), prevention and re-use (12), safety, isolation, management and control (30), environment (8), alternatives (7), international (6), political/administrative (5). [The list of arguments is available in Dutch.]
The significance of arguments, and their importance, appears only when their robustness is indicated (by the participant, and/or (especially in the case of submissions in the open consultation procedure) by the analyst) and when it is made clear how they lead to a conclusion that supports a position on deep underground disposal. One useful way to analyze robustness is to draw up argumentation scenarios: meaningfully linked arguments and points of departure which lead to a conclusion and a position. If this is possible, links among points of departure, among arguments, and between points of departure and arguments, are made explicit. If not possible, it becomes clear that such links are absent.

2. Patterns of argument and argumentation scenarios

Every public discussion or controversy has one or more foc¿ themes which are considered important by the majority of the participants (irrespective whether they agree or oppose), in the sense that the eventual decision should take these themes into account. A discussion can be mapped by tracing the foc¿ and their evolution in the course of the controversy. The positions submitted in the two consultation procedures show that the discussion about acceptability of deep underground disposal of highly toxic waste is concentrated around six such foc¿, which are also recognizable in the list of 77 arguments, distilled out of the submissions in the open consultation procedure.

The six foc¿ visible in the debate are:

1. Taking future generations into account,
2. Prevention and re-use or recycling (Integral chain management4),
3. Safe disposal according to ICM criteria (Isolation, Control, Monitoring),
4. Retrievability of the waste,
5. Salience of the waste problem,
6. No export of waste.

We have phrased the foc¿ as points of departure, rather than open questions, because the public discussion has accepted that taking future generations into account should play a role, that prevention and re-use or recycling is an aspect to be considered, etc. The discussion is on the how, and on the why behind that. And also, but often less explicitly, about the extent to which one point of departure can dominate another. The construction of argumentation scenarios is a way to make the latter explicit, as we will show below.

Although we can view each of the foc¿ as a point of departure, their consensual/controversial status is different. The last two foc¿ are barely contested. Almost all participants in the consultation procedures agree that waste should not be exported. This is in accord with international standards and agreements. So this can be taken as a shared point of departure. Whether there actually is a waste problem, is not doubted. Scenarios of future waste streams, as presented at the seminar, all conclude that the amount of highly toxic waste will increase. Thus, the recognition of the waste problem as a very real problem, and the requirement to solve the problem in your own country rather than to export it, are boundary conditions for any argumentation that wants to be robust.

The first three foc¿ are closely linked to present environmental and waste policies, as presented in the National Environmental Policy Plan5 in which the concept of ‘sustainable development’ plays a

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4 Integral chain management is the management of the whole product life cycle, with the goal of diminishing the burden on the environment.

central role. Many participants in the consultation procedures indeed refer to sustainable development. In our analysis, we will not use the umbrella concept, but work with the several specifications that are offered.

Almost all position statements refer to one or more of these three foci. That it is necessary to take future generations into account, that prevention and re-use or recycling is desirable, and also disposal according to ICM criteria, is subscribed to by many participants, be it in varying ways, and not necessarily with the same conclusion.

The desirability of retrievability (focus 4) is controversial, and as will become clear later, is closely linked to assessments of safety of deep underground disposal, and of future possibilities to reprocess waste.

There are two reasons why the six foci of the discussion can lead to different patterns of argumentation and different eventual positions.

The first reason is that one of the points of departure is emphasized above another, and overrides the others in reaching the eventual position. For example, if retrievability is considered to be more important than safety, only those solutions qualify in which the safety target does not lead to disposal forms which make retrievability impossible. Or alternatively, if more weight is given to safety, the other points of departure will play their role but only in so far as they do not undermine the safety target.

The second reason is that the points of departure will be elaborated in different ways. This is particularly clear in the case of retrievability, where different criteria are used (partly in relation to judgements of desirability of retrievability). "To take future generations into account," while widely accepted as a general aim, is developed in different directions: for one participant, it means that waste must be removed definitively, for another that no waste may be produced that cannot be recycled, and for a third it implies retrievable storage of waste.

While it is possible to detail the variety of elaborations of the points of departure in scenarios, this becomes very complex. To map the present state of the debate and to assess robustness, it is sufficient to start from the different emphasis on the points of departure, and add detail only when necessary.

We shall construct four scenarios, three of them starting with one dominant point of departure and showing how the argumentation pattern branches out from it. The fourth scenario takes the list of foci and the need to take all of them into account as its starting point. The nature and linkages between the arguments are derived from the submissions in the consultation procedures. Thus, they reflect the present structure of the repertoire of argumentation, rather than any timeless ideal of correctness and logical coherence. This approach of mapping the debate also implies that in constructing different scenarios and patterns of argumentation, we are limited by the data. It turned out to be quite possible to take each of the first three points of departure, "taking future generations into account", "prevention and re-use or recycling" and 'safe disposal according to ICM criteria", as starting point for a scenario. It was not possible to create a robust argumentation pattern in which retrievability or definitive removal was taken as the dominant aim, and thus the starting point of an argumentation scenario. The fourth scenario, therefore, takes as its starting point the whole list of points of departure (in practice: the first four, because the other two function primarily as accepted boundary conditions), and asks which choices will have to be made.

The argumentation scenarios are composed from the arguments identified in the consultation procedures. They are structured as trees, starting with one or more central arguments, which branch out with the help of subsequent arguments. The arguments are presented in boxes with arrows
between them, indicating the flow of the argument toward a final position. Each scenario thus contains several argumentation patterns; adding up to a total of fourteen. These fourteen argumentation patterns map the debate, highlighting the skeletons of robust argumentation available at this stage of the debate. Here, we will just present the scenarios; in the next section, we shall give a brief evaluation.

The scenarios take the arguments submitted at the seminar, and the majority of the arguments that were identified in the public consultation, into account. The remainder (29 out of 77) do not really belong to forceful foci of the debate. They are rather diverse, and hardly articulated. They can be classified, as was done in the Dutch report, with the help of the labels 'environment', 'alternatives', 'international' and 'politics/administrative'. While these arguments are used in submissions, they often remain unsupported. This is the case for arguments under 'alternatives', like storage in nuclear power plants, or in the Sahara, and for an argument like 'the present Minister responsible for disposal of highly toxic waste is of party X, and the program of that party forbids deep underground disposal,' which we classified under 'politics/administrative.'

We emphasize again that our leaving arguments out of the argumentation scenarios does not imply a decision that they are incorrect or irrelevant. It reflects the fact that they are not part of the main lines of argumentation, are outside the forceful foci, and thus, have not been under pressure to have their support and linkages articulated. Because of this lack of articulation, they are not (yet) robust, and cannot be evaluated with the help of our method.
[1] For the decision about deep underground disposal of waste, it is of great importance to take the interests of future generations into account. The present generation is responsible for the production of the waste, and has to make provisions so that man and environment will be protected, and remain protected, against the negative effects of this waste, also in the future. Because of the responsibility toward future generations, it would be better to produce no waste; thus, the emphasis in waste policy must be on efforts toward prevention and re-use or recycling. This implies that one must always choose for the least polluting forms and methods of production. Nevertheless, for the time being, waste generation cannot be completely prevented.

[1.1] Disposal of generated waste in the deep underground is not allowed because, the deep underground may represent a value in the future. The deep underground is the last environmental compartment which is not polluted. It is possible that future generations will want to use the deep underground for other purposes, so we should not trespass on it now.

[1.2] For some kinds of waste (like heavy metals) it is not desirable that they return in the cycle. Since such substances remain poisonous, they must be isolated from the biosphere. It is irresponsible to force future generations to take care of this waste. Thus, the definitive disposal of this waste must be realized now. Because of natural isolation, the deep underground is the safest solution, and active management is not necessary.

[1.3] To reduce the negative effects of dangerous waste as much as possible, the aim must be to render it harmless at some moment. Thus, the waste must be stored retrievably. Different kinds of waste must therefore be stored separately.

[1.3.1] The deep underground is not suitable for such a type of storage.

[1.3.2] The deep underground is suitable for such a type of storage.

[1.4] The waste that is generated must be stored as safely as possible. The deep underground is not suitable, because there are too many uncertainties about long-term behaviour of the deep underground, the influence of the waste on the deep underground, and about the possibility to manage storage in the deep underground over long periods. To intervene when calamities occur is difficult with disposal in the deep underground, perhaps impossible. The risk is thus that future generations will, at some stage, be confronted with the dangers of the waste.
Argumentation scenario #2

[2] The most constructive solution of the waste problem is to not generate waste anymore. Thus, prevention and re-use or recycling of (highly toxic) waste must be emphasized. The means to do so are available. Where possible, a clean (or cleaner) technology must replace the old way of production. Producers of waste must be taxed more heavily. One can avoid generating electricity through nuclear power, and thus avoid the production of large amounts of nuclear waste. The waste that cannot be prevented, re-used or recycled must be made harmless, or stored retrievably, so that future generations can re-use or recycle the waste.

[2.1] Disposal of the waste in the deep underground is not a good solution. The safety of the storage cannot be guaranteed. There are too many uncertainties about the long-term behaviour of the deep underground, the influence of the waste on the deep underground, and about the possibility to manage storage in the deep underground over long periods. To intervene when calamities occur is difficult with disposal in the deep underground, perhaps impossible. The risk is thus that future generations will, at some stage, be confronted with the dangers of the waste. Waste disposal in the deep underground therefore does not meet the ICM criteria. Waste disposal in the deep underground also implies that the waste is not retrievable. When in some future time methods to that extent are developed, the waste cannot anymore made or harmless or be re-used.

[2.2] Waste disposal in the deep underground is the least bad way of waste removal following ICM criteria. With our present technological knowledge, and because of natural isolation, it is possible to store the waste in the deep underground sufficiently safely. Waste disposal in the deep underground is less sensitive to environmental terrorism, war, crashing airplanes etc., because of its natural isolation. Active management (control and monitoring) is thus hardly necessary. The disposal can also be done retrievably, so that one of the most important objections against disposal in the deep underground is removed.

[2.3] Disposal of highly toxic waste in the deep underground takes the interests of future generations insufficiently into account, and entails high costs. In the sense that high costs are an incentive to search for alternatives, disposal of waste in the deep underground is acceptable as a stimulus for prevention and re-use or recycling.

[2.4] With disposal of highly toxic waste in the deep underground, a (cheaper) solution to the waste problem is available, while the waste will become invisible and irretrievable. This reduces the incentives for prevention and re-use or recycling.

[2.4.1] Disposal in the deep underground must therefore be rejected.

[2.4.2] It is only present highly toxic waste that may be disposed in the deep underground. After that, one can start with a clean slate.
[3] A basic principle of present environmental policy is to make sure that man and environment do not experience harmful effects of non-processable waste. Thus, the waste must be stored effectively isolated from the biosphere, and the storage site must be controlled and monitored well. In this respect, we must learn a lesson from dumping in the sea. It would be better to prevent generation of waste, but that is not always possible. Neither are, in most cases, new ways to process waste to be expected in the short term. Therefore, one should choose the safest method of storage.

[3.1] The waste in question remains harmful for a long time (thousands of years). Thus, solutions for a few decades are at best partial. Since it has been proven that the deep underground can isolate harmful substances from the biosphere for long periods, it is sound to move toward disposal in the deep underground. An additional argument is that the soil suffers much more erosion than the deep underground. The safety of the deep underground has been confirmed by the OPLA report.

[3.2] For waste disposal, the Netherlands follows the ICM criteria. Effective control and monitoring are then essential: they are necessary to be able to intervene when the isolation should fail, and reduce the harmful effects to a minimum. In addition, active management links up with the aim to process the waste eventually. For disposal in the deep underground, effective monitoring and control is not possible. But these are necessary, because of the many uncertainties about the behaviour of the deep underground. So it is better to store waste above ground.

[3.3] Disposal of waste has to meet the ICM criteria. Also in the case of disposal in the deep underground, active management is possible. But it is then necessary to store the waste retrievably. Such a reversible storage method in the deep underground is to be preferred to storage above ground, on the basis of safety considerations.
Argumentation scenario #4

[4] The problem of non-processable waste is a serious problem, and a structural solution is demanded. It would be better for the environment if the waste were not generated; production of waste must thus remain at a low level. In the short term, however, it is not an unsurmountable problem if sizeable amounts of radio-active and chemical waste continue to be generated. These wastes have to be stored, well isolated from the living environment. No method to achieve this should be rejected a priori. Space is available in the deep underground, and one should not reject in advance the option to use this space. Selection of method must occur on the basis of safety, the interests of future generations, ICM criteria, possibility of retrieval, etc.

[4.1] From an environmental point of view, it is desirable that the waste will be made harmless at some moment of time. Therefore, the waste should be stored so as to be retrievable. At this moment, there are many uncertainties about the behaviour of the waste in the deep underground. Research must be done to find out if retrievable storage in the deep underground is indeed possible in a safe and economically acceptable way. As long as this has not been clarified, the waste must be stored above ground.

[4.2] The deep underground guarantees good isolation of the waste (see OPLA report). In addition, the waste is retrievable for 50 to 100 years, so that possibly more sustainable solutions can be taken up. If by then no method of processing the waste has been found, it is sensible to move to definitive disposal. The deep underground can therefore be used for storage of waste.

[4.3] Storage in the deep underground is not consistent with the interests of future generations, does not meet the ICM criteria, cannot be guaranteed to be safe, and is not retrievable. So it must be rejected.
3. Analysis of the argumentation scenarios

The scenarios, and the argumentation patterns contained in them, show how arguments are linked up and lead to an eventual position. This reconstruction does not lead to a conclusion, one way or the other, whether disposal in the deep underground is the right thing to do. But that was not what we set out to do. The aim was to bring out the actual and potential linkages between the arguments identified in the consultation procedures.

Some links turn out to be more easy to make than others. If taking future generations into account (focus 1) is foregrounded, it is almost self-evident (for the participants) to find prevention and re-use or recycling (focus 3) important. While there are different assessments of how far disposal in the deep underground meets ICM criteria, the Importance of safety, articulated in terms of the ICM criteria, is a returning element in the scenario's. So safety, and the ICM criteria, are obligatory stepping stones in the argumentative patterns. The difference in eventual positions derives from the different detailed assessments.

Using the metaphor of a landscape, with its hills and valleys, and gradients of inclination and effort to traverse in general, one could speak of the landscape of the argumentative repertoire in the debate on waste disposal in the deep underground. The analyst maps the terrain, by finding out which have become the preferred pathways of the participants in the debate. But it is the shape of the landscape rather than an opinion poll, which is what interests him, and the policy maker.

The four argumentation scenarios are exercises on paper, and can be seen as geodetic experiments: which combinations of arguments can be constructed, and which patterns become visible, which tell us something about the lay of the land (that is, the present "landscape" of the state of the debate, not some unchanging bedrock of correct argumentation that we have to aim for). Other scenarios could be constructed, but we would claim that the patterns -- the linkages between arguments that cannot be undermined, or only with great effort, as well as the junctions, where paths diverge -- will remain the same.

While the different detailed assessments lead to different positions on waste disposal in the deep underground, one should not let oneself be blinded by the differences in outcomes. The debate has progressed sufficiently for the argumentative landscape to stabilize; participants as well as analysts recognize the peaks and the valleys, and while diverging on the route to take through the landscape, share a recognition of what the important issues are.

It is now possible to make a second step. First, we identified arguments in the consultation procedures, and combined them in a limited number of argumentation scenarios. This enabled us to distinguish between arguments relevant for the main lines of the debate (shared roads as well as separate routes, due to fractures in the landscape), and those less relevant at this stage of the debate (independent of the question whether they are correct or not). The second step is to identify robust patterns, and loci of divergence in assessments.

One recurrent and robust pattern (see especially scenarios 1 and 2) is how taking future generations into account (focus 1) is coupled with prevention and re-use or recycling (focus 3), and how this then, via the argument that the waste problem remains (in spite of the efforts at re-use or recycling and prevention), leads to a search for solutions that meet the ICM criteria (focus 2). It is only in scenario 2 that retrievability gets greater weight, in the sense that it comes up earlier in the argumentation chain, and helps to determine the nature of the solutions. The reasoning is understandable: when prevention and re-use or recycling are taken as the point of departure, retrievability is a positive factor, because it implies that future possibilities of processing and re-use or recycling can be exploited.
A second recurrent pattern is the divergent assessment of the safety of waste disposal in the deep underground, which is always coupled to arguments about the possibility and desirability of storing waste retrievably. While in the first recurrent pattern the desirability of retrievability was coupled to future possibilities of reprocessing, here it is coupled to an assessment of insufficient safety of disposal in the deep underground. This pattern is fully explicit in scenario 3, and appears in scenarios 1 and 2 in the arguments subsequent to the points of departure 'taking future generations into account' and 'prevention and re-use or recycling'.

Note that we do not discuss the substance of the issue whether disposal in the deep underground meets the ICM criteria. What we highlight is how the diverging assessments form a recurrent pattern, and how this couples, in specific ways, to the theme of retrievability (focus 4). When two problems with divergent assessments interact, there might well be a "wicked" problem. Rather than trying to solve it, we map its features in the argumentative landscape. Participants in the debate, including policy makers, can see their surroundings more clearly now, and plan their route accordingly.

There is a third recurrent pattern: the way that the uncertainty about long-term circumstances of waste disposal in the deep underground surfaces in argumentation patterns. In pattern 1.4 it occurs, and this in relation to focus 1, but it returns in patterns 2.1 and 4.1. If one is risk averse, uncertainties are an argument against (in this case) disposal in the deep underground. Some postpone a decision and ask for more research, others doubt if research will be ever be able to provide conclusive insights on this point.

In addition to the recognition of recurrent patterns, a conclusion is possible about the ordering of the focal themes. Rephrasing our description of the recurrent patterns, we can say that there is a de facto argumentative hierarchy:

- Firstly, that there is waste, and that there will be waste, about which the Netherlands should do something, is recognized by everybody (saliency, focus 5).
- Secondly, that one should take future generations into account is a point of departure that nobody opposes, and similarly for prevention and re-use or recycling, which is linked to the future generations theme.
- Thirdly, safety, and its operationalization in ICM criteria, is accepted as a relevant point of departure by everybody.
- Fourthly, at this level, differences emerge that are practically irreducible, at least for the moment. Can disposal in the deep underground meet the ICM criteria?
- Fifthly, an additional argument about uncertainties (about long-term circumstances of deep underground disposal) shows up difference in attitudes toward risk taking: in a risk-averse attitude, uncertainty is a sufficient argument to reject deep underground disposal, while risk-management attitudes look for solutions, like retrievability, which allow handling of the risk when it materializes.

What is a low-level and, in a sense, technical problem: how to meet ICM criteria, becomes an issue of public debate because of uncertainties and the various attitudes to face uncertainty. Because of this, the issue of retrievability becomes salient, and a focus of the debate which could turn over the present hierarchy. For the moment, it is primarily an open and contested issue: what is retrievability? Which disposal routes are retrievable? Is retrievability at all possible with deep underground disposal? As long as the contest is carried on within the present argumentative hierarchy, in which the higher levels have become stabilized (at least in the Netherlands), one can try to address the issue as a
technical problem, where research and other ways of articulation of the issue will contribute to progress.

Our exercise with argumentation scenarios, however, shows that the different assessments of safety, which are foregrounded in scenario 3, are irreducible. If other points of departure are used to construct a scenario (as in 1 and 2), the difference in assessment occurs. What the other points of departure do is to introduce additional arguments, which modify the choice for or against disposal in the deep underground. Thus, the assessment of safety will become further articulated (and more complex). One has to actually go through this process of articulation to find out whether it can resolve the issue of safety or not. So the irreducibility is not a logical point, but what one could call a historical point.

The reason why we reconstructed the argumentative landscape of the debate was to clarify the policy choice for or against deep underground disposal. What has become clear is that there is no logically robust position. Societal robustness, however, which may be even more important for policy, is present, at least to some extent. The importance of future generations, and prevention and re-use or recycling, are stabilized parts of the landscape. After that, the only robust part is the recognition that there is uncertainty. Implicit in our analysis is the point that research per se will not resolve such uncertainties; only when it is part of an ongoing articulation process. So it is important to continue, and improve, such articulation processes. Reconstructing argumentative landscapes, and offering the mapping to participants in the debate, is one contribution to such an articulation process. This is what we have done in this report.

If a policy decision has to be made now, policy makers have to anticipate on the outcome of such articulation processes, as well as to elaborate their own way of decision making under uncertainty. Anticipations can be improved through research, especially research in the dynamics of public controversies. Decision making under uncertainty also depends on attitudes of risk aversion or risk embracing.

Reconstructing the argumentative landscape, as we have done, does not have a direct or linear impact on policy making. Rather it opens up spaces for policy action, or in other words, releases the initiative to the policy. Our identification of the importance of 'retrievability' as a contested issue does not foreclose any policy options. Indeed, the importance of the issue is known already. What we have done is to show how it is located in the argumentative hierarchy; or in terms of our metaphor: where the crossing of roads is located in the landscape. Thus, the issue can be put on the policy agenda in a more structured way, and treated accordingly.
Appendix on Method

Used in "Radioactive Waste Disposal: Taking Societal Views into Account"

Analyzing the heterogeneous material produced in consultation procedures cannot be done with traditional approaches of policy analysis, which are oriented to the analysis of a problem, or the analysis of one or a few (policy) documents. Here, there are views and arguments of varying nature and status, and their force derives also from the fact that they have been submitted in a consultation procedure.

By viewing the material as a product, and thus an indication, of the repertoire of views and arguments that characterizes the controversy at this stage, other methods of analysis can be mobilized, and we will set them out briefly in this appendix.

We would argue, in addition, that the notion of 'repertoire' is important to understand the dynamics of controversies, and offers new possibilities for policy making. Traditionally, controversies like the one about burial of waste in the deep underground have been seen as reflecting a problem that has not been solved, and policy makers should work towards actually getting this problem solved. Over the last decades, when it became clear that technical problem solutions did not make the controversy go away (partly because different participants see different problems), the policy makers saw their task as one of conflict resolution, or at least conflict management. While important, the substance of the controversy may be lost out of sight in the eagerness to restore the peace. Studies of the dynamics of controversies have shown that there is a third aspect: the improvement of argument, the articulation of views, the learning which positions can and which cannot be maintained, the increase in robustness of certain other positions, and thus a partial closure. We have called such developments 'repertoire learning', because it is not individual learning, but an improvement of the repertoire relevant to the issue and the arena. The controversy, or rather, controversies, about smoking and health provide striking examples (See Rip 1986b).

When policy makers recognize the possibility of this dynamic, they can work towards (further) repertoire learning, and design their measures to suit this purpose. The mapping of the repertoire then becomes an important first step. The methods to do so are then not just a way to handle the heterogeneous material that is produced by a consultation procedure; they are policy-relevant in their own right, and the analysis can lead to policy advice. After setting out the methods, we will briefly come back to this point.

Mapping the repertoire

The notion of 'repertoire' has been used to describe and analyze the content of a culture or a subculture, say of a community, or an occupational group, or an organisation. The repertoire of stories, metaphors and images of an organisation has become recognized as an important factor in shaping atmosphere, work, success, and is now treated as an opportunity to develop management tools.

Repertoires emerge in mutual dependency situations with some shared activities and a certain boundary towards the "outside." Seen in this general way, it can be applied to controversies as well: there is a limited set of issues and participants linked to each other, an (evolving) arena as it were with an (evolving) agenda. One can trace the repertoire by identifying the arena and reconstructing the repertoire of its participants; and/or by identifying the agenda, and reconstructing the repertoire through analysis of documents and other contributions to the agenda.
In the case of the consultation procedures in the Netherlands, a mixed approach was used. For the seminar, key participants were invited to document and discuss their arguments, and this provided us with the data to map the repertoire. For the public hearing, no bounds were set on participants, but the submissions had to relate to the issue. This entrance point into the repertoire allows a broader scope, but may also include noise. One way to distinguish signals from noise, without biasing the analysis by throwing out arguments or views because one thinks they are irrelevant or plain silly, is to have a closer look at their authors. While we did check the source of the submissions, we did not choose to delete possible outliers. The check was important to interpret certain features, like the frequent recurrence of a few standardized arguments. Standardized responses had been printed, and people needed only to sign the sheet and send it off to have a submission.

At a later stage in the analysis, there was a possibility to distinguish relevant from not-relevant at this moment by finding out what could be included in argumentation scenarios, and what was not worthwhile to try to include. We listed the arguments that were not included separately, and discussed our reasons. So others could, if they so wished, create different scenarios with different inclusions. Our contention is, however, that we have mapped the central part of the repertoire as it characterizes the state of the controversy.

**Argumentative patterns**

In our analysis, we were not interested in all elements of the cultural repertoire of the controversy. For example, we did not consider the style of discussing and the way conflicts tend to be resolved (which is different in different countries), although these are interesting features, and are important to estimate the feasibility of conflict resolution measures.

Our interest was in the arguments and reasoned positions, and in the argumentative patterns that might be important. In the main text, we have used the metaphor of *argumentative landscape* to refer to this aspect of the repertoire. A landscape is shared by the participants, you can move about it, in it, and take different paths. Some paths are easier than others, and the landscape can be moulded, intentionally and unintentionally, and such changes shift the gradients. One should not take metaphors too far, but one can see how putting a lot of work in finding ways to contain toxic waste, and being somewhat successful, is shifting the gradients of argumentation about deep burial in the same way as flattening a hill and building a new road does. The argument about retrievable storage for 50 years and then see how much technical progress we have made, is like keeping the hill as it is (or the town with its narrow and winding streets) and building a bypass.

If this metaphor adequately captures what the argumentative repertoire in a controversy is, the next step is to isolate the building blocks (arguments and positions) and their linkages. If one has one document only to analyze, a variety of methods is available.

One cluster of methods derives from Stephen Toulmin’s seminal work on argumentation, and uses his structuring of practical reasoning: data are provided for a claim, there is a warrant to go from data to claim, and there is backing to support the warrant (or the conditions under which the warrant is valid). In practice, argumentation is elliptic, and the analyst has to complete it in order to make the structure, or better, the possible structure, visible. Schellens, who has analyzed a discussion in the Dutch newspapers, 1981-1982, on burial of radio-active waste in salt formations, notes that the Toulminian scheme captures certain types of argumentation very well, but others, like reasonably invoking authority, or reasoning by example or by analogy, much less. His analysis is oriented to the characterization and evaluation of the arguments of the several participants in the debate, not to a characterization of the repertoire.
A second cluster of methods derives from the new rhetorics of Perelman and Olbrechts-Tyteca, where effective argumentation is foregrounded rather than reasonable argumentation (there is a lot of overlap, though; the difference is primarily in the orientation from which the arguments are evaluated). The new rhetorics have broadened out and become fashionable (cf. also Enos and Brown 1993). For our purpose, the methods are important, not the substantial discussions, e.g. about the rhetorics in scientific discourse. Rhetorical analysis, as we see it, is the analysis of how force is exerted in and through text and speech, with particular emphasis on how forceful associations are put up. The Toulminian scheme then is one, and recurrent, form of forceful association, and one where the force derives from the structure of the argument, rather than the content of the data or the backing. But there are other schemes, for example where strategic assessments and inference carry the force. How actors position themselves in a debate or controversy allows inferences as to the strength of argumentative linkages. For example, while the tobacco companies had been fighting the link between smoking and health (particularly, cancer) with data, arguments, and other weapons, at some time during the 1970s, they realized that they were not reaching their audience anymore with this kind of argument, and stopped with their emphatic criticism of the smoking-cancer link. In the public debate, this then led to a new kind of argument: ‘If even the tobacco companies do not criticize the smoking-cancer link, it must be true.’ This was an irreversible shift in the dynamics of that controversy. (See Rip 1986b for more details.)

A third cluster of methods is of more recent origin, and derives from literature, text analysis and culture studies. It is variously called discourse analysis, narrative analysis or cultural analysis. The force of an argument is seen to derive from the cultural schemata into which it fits, or from the story and its emplotment, or from socio-cultural definitions of what is natural and obvious. An example is the way ‘the endless frontier’ schema allowed Kennedy’s argument for putting a man on the moon before 1970, to be more convincing than it would have been otherwise. At the level of analysis, one can trace such forces sometimes by looking at the modalities and the sequencing devices in the text. Compare for example the effect of “Until now, gas separation with the help of membrane filtration is not yet applied in our country,” with the effect of “Gas separation with the help of membrane filtration is not applied in our country.” The data are the same, but the framing is different, and the implicit scenario of the first phrase (“but it will, or should, be applied”) derives its force from a cultural schema of ‘inevitable progress’. (The example is drawn from a detailed analysis in Van Lente 1993.)

For our purposes, the isolation of the main building blocks is important, not the detailed analysis of concrete argumentative patterns. Because the data are drawn from explicit submissions, they are already shaped so as to bring the arguments and their linkages out. When necessary, we fell back on our argumentative intuition, as supported by our experience with rhetorical analysis, discourse analysis and narrative analysis to make sensible choices; for example by looking at the sequencing or the modality.

The modality with which an argument or a claim is expressed is particularly important to find out what is generally accepted. Or, more generally, what is sufficiently robust to withstand critical deconstruction. For scientific articles, such modalities have been traced as evolving from: ‘We speculate that …’ or ‘X might be caused by …’ or ‘Some authors have suggested that …’ for the uncertain; via ‘It is probable …’ or ‘X appears to be caused by …’ or ‘Smith and Jones have noted that’ for the plausible but still not robust; to ‘It is certain that …’ or ‘As it is well-known that X causes …’ or ‘…’ (i.e. the claim is made without there being any need to refer to sources). In other writing, similar gradings of certainty, acceptance and robustness can be distinguished. In our data, qualifiers like ‘naturally’ or ‘It is obvious that’ can be used as indicators of robustness, or, tactics to try and claim robustness for one’s less certain or less accepted point.

Once building blocks have been isolated, one can trace their modalities across the whole set of data. Not just as arguments for a particular position, but also in the way the arguments for another position are referred to. If these are addressed, and in a way that it is clear that the author feels s/he
is forced to address them (because of the state of the controversy), then we have found a focus of the present state of the controversy. The modalities of presentation then allow us to decide whether this focus has been articulated and accepted, so as to become available as a boundary condition to all argumentative patterns, or a point of departure that has to be used, as a starting point or later on in the argument, or whether it is a "wicked" focus which is full of uncertainty and divergence, at least at this stage. Note that we are not interested in everything that is uncertain, but in those problematic issues that have to be addressed, because they are a focus of the controversy.

Up to this point, the analysis maps the state of the repertoire in the same way as a sociologist would do, using certain methods to find out what is the case, even if these are never fully objective, because they require judgements of the analyst in a number of places. In our analysis, we have gone one step further in order to evaluate the argumentative repertoire. We wanted to find out what the structures of the main argumentative patterns were, and whether the "wickedness" of one or more foci was related to a problem in the argumentation, or not (and if not, it might have a variety of causes, including unconstrained interest politics).

So we went back to argumentation analysis, and the basic Toulminian scheme, and used it as a shell to build a number of argumentation scenarios, using only the main building blocks, and leaving out most of the data and backing, only referring to their presence or absence. A path through such an argumentation scenario will specify an argumentation pattern, and one that qualifies as argumentatively sound, because the steps necessary for sound argument are taken.

The argumentation patterns we created in this way need not coincide with any concrete argumentation found in our data, or elsewhere. They highlight what the argumentative repertoire has to offer at this stage. And they have a diagnostic aspect as well: not only do we work with what is available (so the limitations of our scenarios and patterns are limitations of the repertoire), we also try to fit the "wicked" foci into the scenarios, and see what happens. One conclusion which we drew in the main text was that the "wicked" focus of retrievability ("wicked" in the sociological sense, in that participants disagree how to handle the issue) plays indeed a wicked role in the argument: It cannot be used as the starting point of a scenario of its own, and when it appears in another scenario, it creates forks in the sequence. This is not to say, we hasten to add, that the issue of retrievability cannot be resolved. It is a diagnosis of the present state of the repertoire.

Reertoire learning and the introduction of forceful foci

The repertoire in a controversy evolves, and when the repertoire at some later stage is better (in terms that must be specified), repertoire learning has occurred. No particular individual need to have learned; the change could have happened through new participants. As we noted in the introduction: some arguments cannot be maintained anymore, others become easy to mobilize. If a participant tries to press one of the untenable arguments, the reactions will be such that he will quickly learn that he should not (unless he can come up with a new defense, of course). In terms of our metaphor: the argumentative landscape has changed, and the movements through it experience a different gradient. Even if you do not know the new lay of the land, you will quickly learn the difference between an easy slope and a steep hill.

Repertoire learning has been described by Whitleman (1982; 1985), though without using the concept, for the utilisation of OTA reports by the American Congress. He identifies substantive, elaborative and strategic use, and describes outcomes, including repertoire learning: "There were some arguments that people were making that were just dropped because they didn't make sense anymore in the light of the OTA report." (Whitleman 1985, at p. 221). He then goes on to note that strategic use of analytic information (which some might decry as improper) actually increases the sophistication and may shift the focus of Congressional debate, exactly because strategic use occurs in situations where
Interests are at stake, and proponents and opponents have to be careful about the quality of their weapons, including the analysis and arguments they use. We add that it is not a coincidence that strategic use is more frequent when the topic is controversial. The further implication is that attempts to reduce strategic use might actually diminish the amount of learning that occurs on the basis of an OTA report.

Repertoire learning does not occur automatically, just as new knowledge or new analysis will not be utilized already because it happens to be there. There must be an incentive, and controversy is one incentive. When the socio-cognitive dynamics of controversies are traced (see for such an analysis, and references to relevant literature, Rip 1986b), two features stand out.

One is that forceful foci are necessary for further articulation and possible agreement or accommodation; otherwise, too little is at stake, and parties prefer to go their separate ways. Intended government regulation or policy making can be such a forceful focus; a credibility problem (say, for chemical industry and environmental impact of its processes and products) can be another.

The second feature is that the actual nature and sequence of the forceful foci determines the content of the eventual resolution, including the content of the repertoire then achieved. Those issues will have become articulated and will have led to robust insights that were at stake at some earlier stage. In the 1970s controversy over recombinant DNA research in laboratories, the risk of escaping micro-organisms quickly became a focus, and when it turned out that these could be contained (through the use of "crippled" micro-organisms and through bureaucratic classification of extent of risk and nature of precautions), and there was no other forceful focus, the controversy closed and the implicated repertoire was consolidated. "The risk of r-DNA research appears to be considerably less than initially believed," (true) became: "The risk of r-DNA research is negligible." Insofar as there still was debate, it centered on the actual use of r-DNA technology in production processes and products, but there different issues were at stake.

The implications of this brief excursion to the socio-cognitive dynamics of controversies are that repertoire learning occurs better when there is something at stake, and that this can be understood because it is in and around a forceful focus that articulation occurs. Consolidation, the second feature of robustness, may be, but need not be, the end result of such a dynamic. It is difficult to decide whether consolidation has occurred prematurely, and should be broken up -- even apart from the question whether some participant might actually be able to break up a consolidated position.

A policy implication is that when lack of articulation and consolidation is diagnosed, the policy maker should stimulate repertoire learning, and the best instrument to do so is to create a forceful focus. In our case, this would be to decide about a policy that addresses retrievability, the "wicked" focus. Not because the policy maker has found the right answer, or has resolved the conflict between the parties, but because he sets learning in motion. Thus, it is not decisive which way the policy takes up the retrievability issue, as long as it does take it up. The learning that occurs then may lead the policy maker to revise his original choices, but that should not be a problem.
Bibliography


