Enabling participation

A vision on public participation in decision-making about long term radioactive waste management

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Prologue

The Netherlands faces a challenge. A permanent solution must ultimately be found for disposal of the radioactive waste produced in the country, which is currently placed in safe temporary storage by the Central Organization for Radioactive Waste (COVRA).

Effective and safe management is essential: high-level radioactive waste remains harmful for hundreds of thousands of years, with serious potential implications for people and the environment. In the time that radioactive waste remains hazardous, many generations of people will come and go, nuclear physicists will continue to develop new technologies, international boundaries will change or disappear and geopolitical tensions will remain as unpredictable as ever. Scientists have been investigating ways of safely managing radioactive waste for several decades.

Decision-making about radioactive waste management is characterized by technical uncertainties, public concerns, political preferences and international influences. EU member states have agreed[1] to submit national programmes for decision-making about radioactive waste to the European Commission by August 2015. Each country's national programme is to include information setting out how the public will be given the opportunity to participate in the decision-making process. But at what stage should the public be involved? And who is 'the public' anyway?

The Rathenau Instituut studies developments in technology and highlights their implications for society and for policy. Through dialogue regarding social and technological developments, it is possible to build up a picture of the concerns and expectations of the public and stakeholders, and to identify the policy options that are likely to receive support. Public participation is therefore an important theme of the Rathenau Instituut's work programme for 2015-2016.

In connection with its development of the Dutch national programme, the Authority for Nuclear Safety and Radiological Protection (in Dutch, Autoriteit Nucleaire Veiligheid en Stralingsbescherming: ANVS)[2] asked the Rathenau Instituut to formulate a vision on public participation in decision-making about the long-term radioactive waste management, to serve as a supporting study for the national programme.

The requested vision is set out in this report. The long-term radioactive waste management is a complex intergenerational problem. Hence, the vision presented here is underpinned by two convictions. First, it is not sufficient to involve only the general public in decision-making about the long-term radioactive waste management. Second, public participation depends on thorough and prompt preparation, with responsibility shared by various stakeholders. The realization of public

[1] Under Directive 2011/70/Euratom, which is considered in Chapter 1 of this report.
[2] When this project was commissioned, it was under the auspices of the Programme Directorate for Nuclear Facilities and Safety (NIV) at the Ministry of Economic Affairs. With effect from 1 January 2015, the activities of the latter Directorate – and therefore responsibility for this project – were transferred to the Authority for Nuclear Safety and Radiological Protection (ANVS).

participation in this complex field will additionally be influenced by the public's trust in government and willingness to participate.

The vision presented here is the product of focus group discussions, in-depth interviews and a literature study. The public focus groups[3] had a major influence on the course and outcome of the project. In response to the input received from the focus groups, the decision was made to realign our research work. The original intention had been to begin with public participation, but it became apparent that that was not a viable approach in a context in which there is limited trust in the government with regard to this specific policy issue. The importance of discussing the vision of public participation with stakeholders also became increasingly clear, causing us to adjust our approach accordingly.

The project was overseen by a specially created steering committee made up of people with various perspectives on the relevant issues and, in some cases, diverse interests. The committee helped us to produce a report that covers a wide range of outlooks.

This report has been written for the Authority for Nuclear Safety and Radiological Protection (ANVS). The activities described and the recommendations contained in this report therefore relate to the ANVS, in order that they may serve as input for development of the Dutch national programme (Nationaal Programma). The ANVS will in due course present the national programme to the lower house of the Dutch parliament and to the European Commission.

Dr Melanie Peters
Director, Rathenau Instituut

[3] Focus groups made up of members of the public

Content

1 Introduction

1.1 Background

Our society produces radioactive waste of all levels (low-level, medium-level and high-level radioactive waste). Radioactive waste is unwanted material that emits ionizing radiation. Prolonged exposure to such radiation is harmful to people and the environment. High-level radioactive waste can continue to emit harmful radiation for more than a hundred thousand years: an almost unimaginable length of time in human terms.[4] High-level radioactive waste is therefore the most problematic form of radioactive waste, but even medium-level radioactive waste can be hazardous for decades or centuries. Constant vigilance is therefore necessary to prevent the unsafe use of radioactive waste – and even possibly its deliberate abuse, e.g. by terrorists.

In the Netherlands, the sources of high-level radioactive waste are the nuclear power plant at Borssele, the closed nuclear power plant at Dodewaard and the research reactors at Petten and Delft. The medium-level and low-level radioactive waste produced in the Netherlands includes needles, tools, clothing and gloves used in places where people work with radioactive substances and radiation. Such places include hospitals, research laboratories and industrial establishments. Table 1 provides an overview of the volumes of radioactive waste produced in the Netherlands. In comparison with other EU member states, the amounts of radioactive waste produced in the Netherlands are relatively small.

Tabel 1 Volumes of radioactive waste produced in the Netherlands in 2013 (COVRA, 2013).

Level	**Stored volume in m^3 (produced in the period 1982-2013)**	**Average annual increase in volume in m^3 (based on the period 2008-2013)**
High-level	85,6	9,2
Low-level and medium-level	27.967	1.947

It is important that radioactive waste is safely collected, processed and stored, so that it cannot escape into the environment. The principle underlying current Dutch government policy is that all radioactive waste produced in the Netherlands should be collected and stored in an above-ground storage facility – specifically by COVRA (the Central Organization for Radioactive Waste) on its site in the municipality Borssele – for at least a hundred years. However, by 2130, a long-term mechanism for radioactive waste management has to be operational, implying that decisions about the nature of the mechanism to be adopted need to be made well before that time. Although it has

[4] One of the properties of radioactivity is that is reduces over time.

yet to be determined how and where long-term management will be provided, it has already been decided that radioactive waste must be retrievable and, indeed, that also the entire process of long-term waste management must be reversible (lower house of the Dutch parliament, 2002). That implies that, with reuse and manageability in mind, stored radioactive waste must be retrievable.[5] In addition, the storage of radioactive waste must be consistent with the criteria of isolation, control and surveillance (the so-called IBC criteria).[6]

Box 1: Nuclear energy and nuclear waste policy in the Netherlands

Part of the remit for this report was that the relevant issues should be explored on the assumption that, in the Netherlands, radioactive waste will continue to be stored safely by COVRA until 2130.

Current Dutch government policy on radioactive waste is defined in a number of cabinet policy statements and written statements to the lower house of the Dutch parliament[7]. Concerning radioactive waste management, the adopted policy has resulted in the construction of facilities for the temporary above-ground storage of low-level, medium-level and high-level radioactive waste at COVRA in Borssele.

The policy also requires that waste placed in underground storage is retrievable, implying that for reasons of controllability, the process of disposal involved must be reversible. In addition, the storage of radioactive waste must be consistent with the criteria of isolation, control and surveillance (the IBC criteria; lower house of the Dutch parliament, 2002).

A 2012 Parliamentary Paper on amendment of the Radioactive Waste Decree in connection with the implementation of the Euratom Directive (lower house of the Dutch parliament, 2012), makes a further requirement: in order to ensure that radioactive waste can be stored in accordance with the IBC criteria, all such waste must be stored safely for at least a hundred years on a single site in the specially designed facility at COVRA. During that time, the necessary funds are to be set aside for the realization of a permanent repository and research is to be undertaken to acquire the knowledge required for the realization of such a facility.

Some of the stakeholders interviewed in connection with this report[8] raised questions about the hundred-year decision-making period and the basis for its adoption.[9] Doubts about the hundred-year period were also expressed in the submissions made during consultations on the national programme, e.g. by the World Information Service on Energy (WISE) (WISE, 2013). The 1984 Policy Document on Radioactive Waste made reference to a few decades of interim storage for

[5] The notion of reversibility and retrievability is considered in more detail in Box 5.
[6] See Box 1.
[7] The 1984 Policy Document on Radioactive Waste (lower house of the Dutch parliament, 1984) and the 2002 policy statement (lower house of the Dutch parliament, 2002) on the final report of the Committee on the Storage of Radioactive Waste (Recoverable Disposal: a viable option?; CORA, 2001) are the main examples.
[8] Interview with Herman Damveld (11 May 2015) and with Leo van de Vate (19 May 2015).
[9] The legal-administrative status of the hundred-year period is outside the scope of this report.

high-level radioactive waste and a century of interim storage for low-level and medium-level radioactive waste. That would imply that a permanent repository for high-level radioactive waste should be realized in a few decades, instead of a hundred years. The government would then have to make a decision regarding a permanent repository for radioactive waste much sooner, and that would inevitably have implications for public participation in the associated decision-making.

In this report, we consider when and how the government should involve the public in decision-making about the long-term radioactive waste management. In other words, when and how the process known as 'public participation' should be organized. In the context of the deliberations regarding the nature and timing of public participation, the principle that all radioactive waste should be stored above ground until 2130 plays a central role. However, the precise political-administrative status of the adoption of 2130 as a pivotal date for Dutch policy remains unclear (see Box 1).

Public participation can take a variety of forms, ranging from simply informing people about what has been decided to involving people in decision-making about potential storage locations. One of the reasons why public participation is important is that decisions regarding the long-term radioactive waste management has implications not only for the people alive today, but also for future generations.

In November 2013, the Programme Directorate for Nuclear Facilities and Safety (NIV) at the Ministry of Economic Affairs asked the Rathenau Institute to formulate a vision of public participation in decision-making about the long-term radioactive waste management. That request was prompted by Directive 2011/70/Euratom, which requires each EU member state to submit a national programme (in Dutch: Nationaal Programma) to the European Commission by August 2015. The Directive also states that, subject to national law and international obligations, the public must be given the opportunity to participate in the process of decision-making about the long-term management of spent nuclear fuel and radioactive waste.

In January 2015, the Authority for Nuclear Safety and Radiological Protection (ANVS) was established, with the aim of concentrating knowledge of and skills in nuclear safety and radiological protection within a single body. Previously, expertise in and responsibility for such matters was divided across various government bodies, including the Programme Directorate for Nuclear Facilities and Safety (NIV) at the Ministry of Economic Affairs. The activities of that Directorate were consequently transferred to the ANVS (ANVS, 2015). At the start of June 2015, a bill was submitted to parliament, which provided for the ANVS to become an independent governmental organization (QUANGO[10])[11]. Pending enactment of the bill, the ANVS remains part of the Ministry of Infrastructure and the Environment, with the responsibilities and powers of the planned QUANGO. Creation of the ANVS resulted in responsibility for development of the Dutch national programme passing from the Programme Directorate for Nuclear Facilities and Safety to the ANVS. This report has been written to help the ANVS develop the national programme for the Netherlands.

[10] Quasi-autonomous non-governmental organisation.
[11] Lower house of the Dutch parliament, 34 219, Amendment to the Nuclear Energy Act in connection with the creation of the Authority for Nuclear Safety and Radiological Protection.

This report sets out a vision of public participation in decision-making about the long-term radioactive waste management. It has been written for the Authority for Nuclear Safety and Radiological Protection (ANVS). The activities described and the recommendations contained in this report therefore relate to the ANVS, in order that they may serve as input for development of the Dutch national programme[12]. It covers matters such as the role of public participation in decision-making and its significance for the public, science, stakeholders and the government.

The core message of the vision is as follows:

> **Each EU member state is obliged to formulate a national programme for the long-term radioactive waste management. Public participation is part of the national programme. Because the long-term radioactive waste management is a complex intergenerational problem, public participation is both necessary and challenging. It is not sufficient to involve only the general public: good public participation also involves lower tiers of government, stakeholders and the scientific community. Moreover, trust in national government and collective willingness to participate are essential preconditions for successful public participation. Steps must therefore be taken to ensure that those conditions are met before proceeding further.**

1.2 Research method and structure of this report

Public participation is a broad concept. The Rathenau Institute considers public participation to be the involvement of the whole community – including the scientific community, the various tiers of government, the general public and stakeholder groups (NGOs, local citizens' groups and the business community) – in decision-making. We recognize a number of forms of public participation: citizen participation, stakeholder participation, intergovernmental participation and scientific community participation.

In our research, we have sought – partly through the use of participatory methods – to build an understanding of how the wider community wishes public participation to be realized and what role the citizen should play. To that end, we organized a series of public focus group meetings. A detailed description of our research methodology is presented in Annex 1, where information is also provided about the composition of the focus groups and other such matters. A report on the focus group sessions is available from the Rathenau Institute website[13]. A literature study was also carried out to collate information about experience with public participation in other European countries. In support of that study, stakeholders from Sweden, the United Kingdom, Germany and Belgium were interviewed. The organizations contacted in that context are listed in Annex 2. Finally, interviews

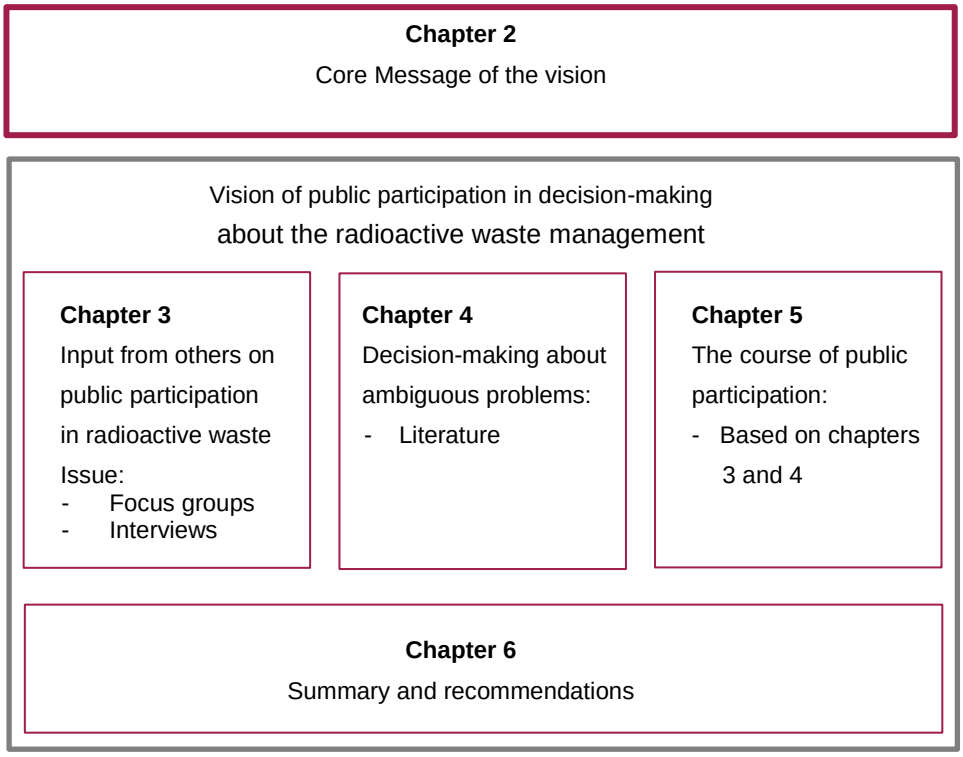
[12] That does not imply that it is the ANVS that must act upon this report. It is preferable for public participation to be implemented by an organization that is more remote from the decision-making and has less political/administrative interest in the process.

[13] www.rathenau.nl/.

were held with stakeholders from the Netherlands, to discuss the findings of our international interviews, focus group sessions and literature study.

The structure of this report is illustrated in Figure 1. The diagram also shows how the various forms of research and data collection relate to each other and contribute to our vision of public participation in decision-making about the long-term radioactive waste management.

Figure 1 Structure of the report



Rathenau Instituut

The Rathenau Instituut's vision of public participation in decision-making about radioactive waste in the Netherlands is presented in Chapter 2. In the following chapters, we explain how we arrived at that vision. Chapter 3 considers the concept of public participation: what it means and how – in the light of the feedback from the focus group meetings and the interviews with stakeholders at home and abroad – we perceive it in relation to long-term radioactive waste management. We argue that public participation is desirable, but by no means self-evident. Chapter 4 is devoted to a number of practical aspects: what are the characteristics of the radioactive waste problem and what do they imply about the evolution of public participation in the associated decision-making process? Chapter 5 brings together our findings regarding public participation and the characteristics of the radioactive waste problem and outlines how public participation in decision-making about long-term radioactive waste management may evolve over time. Finally, Chapter 6 contains a brief summary of this document's contents and sets out our recommendations to the ANVS with regard to public participation in decision-making about radioactive waste in the Netherlands.

2 Vision of public participation in decision-making about radioactive waste

As stated in the introduction to this report, the core message of the Rathenau Instituut's vision of public participation in decision-making about the long-term radioactive waste management is as follows:

> **Each EU member state is obliged to formulate a national programme for the long-term radioactive waste management. Public participation is part of the national programme. Because the long-term radioactive waste management is a complex intergenerational problem, public participation is both necessary and challenging. It is not sufficient to involve only the general public: good public participation also involves lower tiers of government, stakeholders and the scientific community. Moreover, trust in central government and collective willingness to participate are essential preconditions for successful public participation. Steps must therefore be taken to ensure that those conditions are met before proceeding further.**

To support the core message of our vision of public participation, we have formulated six recommendations to the ANVS (see also Chapter 6).

1. **Be clear about the role of nuclear energy**
   In the context of public participation, it is important to clearly state the relationship between nuclear energy and radioactive waste, since decision-making about long-term radioactive waste management and about nuclear energy are inseparably linked. Without an explicit, shared vision of the role of nuclear energy in the nation's future energy supply, public participation would be largely ineffective.

2. **Tailor public participation by using issue-based participation clusters**
   Long-term radioactive waste management is an ambiguous problem. Its three component issues (multinational management, management technologies and site selection) may suit various levels of public participation (from informative to co-decisive) and various forms of public participation. The design of each participation cluster therefore requires individual attention. The site selection is a particularly sensitive participation cluster, which will in practice need to be integrated with the other clusters: research into a particular form of management technologies will have implications for the site selection, for example.

3. **Participation should involve not only the general public, but also the various tiers of government, stakeholders and the scientific community**
   Participation in decision-making about an ambiguous problem such as the long-term radioactive waste management should not be restricted to the general public. The general

public themselves agree that participation should also include the various tiers of government, stakeholders and the scientific community.

4. **It is important to promote trust in national government and willingness to participate**
   Trust in national government and willingness to participate are essential preconditions for effective public participation. Where long-term radioactive waste management is concerned, trust in the national government is not currently strong. The development of a public participation model whose subject matter and procedural design enjoys widespread support, is the best way of bolstering trust and willingness to participate. To that end, regular reflection is required (see recommendation 5).

5. **Start the process of reflection immediately and adjust public participation when necessary**
   Regular reflection on the subject matter and procedural design of the public participation process, and on its ethical aspects, is important for the development and retention of trust and willingness to participate. Reflection provides a basis for public participation in decision-making about the long-term radioactive waste management to adapt it to changing circumstances at home and abroad. In that context, we recommend at least the following three measures:

   - *Development of a shared plan for public participation*
     The various perspectives on public participation should be explored, e.g. by discussing the underlying vision[14] with stakeholders, the scientific community, the various tiers of government and the general public, with a view to arriving at a shared plan for designing the public participation model. The ANVS could start work on this measure in the next year.

   - *Tailoring of participation clusters*
     The subject matter and procedural design of each participation cluster should be developed individually. That can be done on a participatory basis, as soon as the shared plan has been formulated.

   - *Periodic reflection*
     Periodic reflection on the shared plan, on the subject matter and procedural design of the participation clusters, and on the social and technical-scientific context of the long-term radioactive waste management is desirable. The periodic reflection should be repeated until 2025, when the ANVS is required to submit an evaluation of the Dutch national programme to the European Commission. It is recommendable that the ANVS synchronizes this reflection with the national programme progress reporting cycle[15] called

[14] The draft version of this vision has already been discussed with a small group of stakeholders, scientists, government officials and representatives of the general public.
[15] The Directive requires that a report on implementation of the national programme be submitted to the European Commission once every three years, and that the member states perform self-evaluations of their national programmes and their implementation at least once every ten years.

for by the Directive. After 2025, the focus of reflection should shift to the progress and outcomes of the various participation clusters.

6. **The design and implementation of the various participation clusters should adhere to certain ground rules**
   It is advisable that the further design and implementation of the various participation clusters should adhere to certain ground rules (see Box 2), relating to matters such as communication, information provision, demarcation and transparency. It is also important to demonstrate that public participation is taken seriously and not used as a mechanism for 'rubber stamping' decisions that have already been made. It is also advisable that the public participation process should be managed by a body that is independent in political-administrative and commercial terms (insofar as that is possible) and that is open, reliable and transparent.

The following chapters explain how we arrived at the vision and recommendations set out above.

3 Public participation: desirable, but by no means self-evident

In this chapter we demonstrate by reference to the public focus groups, the literature and the interviews that public participation in decision-making about the long-term radioactive waste management is desirable, but by no means self-evident. Subsection 3.1 describes the results from a number of public focus group meetings. Subsection 3.2 seeks to identify the lessons to be learnt from participation programmes in other European countries.

3.1 Learning from public focus groups

3.1.1 Who wants to participate; who is allowed to and who is able to?

The aim of a public participation process is to arrive at decisions about long-term radioactive waste management. It involves not only the general public, but also the scientific community, stakeholders and the various tiers of government. From the focus group meetings, it is apparent that the public envisage each of those groups being involved in a different way[16].

Citizen participation in decision-making about long-term radioactive waste management

The focus group participants generally feel that they should be involved in decision-making, and they accept the principle of participation[17]. Their initial response is therefore to embrace public participation in decision-making about long-term radioactive waste management. The presence of radioactive waste and the recognition that, sooner or later, radioactive waste may be placed in a repository near to where they live are matters of direct relevance to them. The importance that they attach to those issues is due to them associating radioactive waste primarily with public health risks, environmental damage and incidents such as Chernobyl and Fukushima. The resulting sense of involvement is regarded by the participants as a strong argument for participating in decision-making about the long-term radioactive waste management. The fact that future generations must bear the burden (e.g. responsibility for ongoing safe management and the associated costs) of the radioactive waste that the current generation is producing is another reason why participants identify with the problem and are open to the idea of participation.

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[16] The findings presented in this subsection are based on the views expressed at the focus group meetings, which we organized jointly with TNS Nipo.

[17] The most common arguments in favour of participation, which were also articulated by the focus group members, may be grouped under three headings: *moral*, *functional/procedural* and *pragmatic/instrumental*. The moral argument is essentially that participation results in a more democratic policy-making process, in which the public are informed and have the opportunity to contribute to discussion. The functional/procedural argument is that the public can promote the adoption of new ideas. The essence of the pragmatic/instrumental argument is that, if the public participate in the decision-making process, there is more support for what is ultimately decided, and the decision is therefore easier to implement (Goorden and Vandenabeele, 2002).

However, participants also have reservations regarding public participation in decision-making about the long-term radioactive waste management. First, any sense that the problem requires urgent attention is mitigated by the distant time horizon. If no decision is to be made regarding the long-term radioactive waste management for more than a hundred years (as assumed by current government policy), people are not inclined to perceive a pressing need to participate in the process in the short term. Second, the focus group participants regard the problem as extremely complex and consequently doubt whether people like themselves are sufficiently knowledgeable to contribute to the decision-making process. Many feel that it would make more sense for scientists to be involved.

The level of public involvement therefore depends partly on the time horizon. Other important determinants are how urgent people perceive the problem to be and how fair they think it is to leave the problem to future generations.

The focus group participants identified a number of specific aspects of the problem that they definitely would or would not want to have a say over. Choice of storage location and storage technology are considered the most appropriate fields for citizen participation, because they are liable to result in radioactive waste being managed close to home. Another issue that was raised was that citizen participation could have the reverse of the intended effect, because of the complexity of the problem and the 'not in my backyard' phenomenon.

The focus group participants identified a number of ground rules for public participation. We regard the ground rules as important principles and have therefore incorporated them into our vision and recommendations. They are summarized in Box 2.

Box 2: Ground rules for public participation identified by the focus groups

The focus group participants clearly identified ground rules for citizen participation in the long-term radioactive waste management. They are as follows:

- The urgency of the radioactive waste problem must be clear, otherwise there will be little appetite for participation.
- It is essential that people trust the process of public participation.
- Useful public participation in the decision-making process depends on accessible information about the substance of the issues being available to participants.
- The issues on which public participation is sought must be clearly defined and delineated. The public generally prefer to choose between various options (e.g. various above-ground and underground management options, with clearly stated advantages and disadvantages).
- Open and transparent communication about the process and the results of public participation is important during the lead-up to the participation process (communication about the issues and about the process), during the participation process itself (communication about the progress) and following the participation process (use of the results).
- Public participation must be on a voluntary basis and the threshold to participation must be low (e.g. convenient times and locations).

- Some participants would prefer the composition of their consultation group to be the same on each occasion.
- The views expressed must be treated as confidential.
- Public participation must not be organized merely for show or to 'rubber stamp' decisions already taken by others; there must be something that still needs to be decided.
- It is important that the results of the process are communicated from one generation to the next.

Scientific community participation in decision-making about long-term radioactive waste management

Focus group participants have a lot of confidence in the scientific community when it comes to making decisions about the long-term radioactive waste management. The participants regard long-term radioactive waste management as a complex technical problem and therefore expect the scientific community and experts to undertake the necessary research ahead of any consultation exercise. The participants nevertheless have misgivings about the independence of the scientists involved and their ability to reach consensus. If views within the scientific community differ, the focus group participants would like to see an open debate amongst the scientists as a basis for the public to form opinions.

In the context of public participation, the focus group participants regard the scientific community's primary tasks as providing information and carrying out research. Information and research are needed mainly with regard to topics such as the available storage technologies and suitable sites for a geological repository. Members of the public involved in the decision-making process need to be presented with various options and scenarios, each with clearly stated pros and cons.

Focus group participants also point out that the scientific community could possibly play a direct role in decision-making about long-term radioactive waste management. Some participants have reservations, however, insofar as opinions often differ within the scientific community. The conclusion amongst participants is that it is a mistake to group all scientists together in the context of public participation.

The issue of radioactive waste management has technical, ethical, social, economic, psychological and other dimensions and therefore transcends various academic disciplines. It is important to retain sight of the issue's multidisciplinary character and the consequent need for interdisciplinary cooperation. Moreover, a wide variety of academic organizations, including universities and public knowledge centres such as TNO and the RIVM, have the potential to play important roles. It is vital to maintain the independence of such organizations. Any apparent conflict of interests is liable to seriously diminish trust in the scientists or scientific organizations concerned (Blankesteijn et al., 2014).

Involvement of stakeholders in decision-making about long-term radioactive waste management

In the context of the focus group sessions, the label 'stakeholders' applies to NGOs and businesses. The term 'NGO' covers both well-established entities such as Greenpeace and local community action groups and the like. An example of a community action group – a body set up by the members of a community to campaign on a particular issue – is Laka[18]. Laka is closely involved in the debate on the radioactive waste management and the production of nuclear energy. The term 'stakeholder' is additionally applied to partially state-owned companies, such as Energiebeheer Nederland (EBN) and COVRA.

The focus group participants see stakeholders (NGOs and businesses) as having a limited role in decision-making about the long-term radioactive waste management, because of the diversity of their interests. The main contribution that stakeholders could make is critical analysis and comment. The topics on which useful input might be provided vary from one type of stakeholder to the next, and include matters such as appropriate management technologies and sites and economic viability of the available options.

Involvement of various tiers of government in decision-making about long-term radioactive waste management

The participants trust the national government and the political community less than they trust the scientific community in relation to long-term radioactive waste management. That is mainly due to the perceived lack of transparency (in the way decisions are reached) and the perceived lack of information about long-term radioactive waste management. Another significant factor is the perception that a variety of interests are at work within the political community and government. The focus group participants therefore see the government's role in decision-making about long-term waste management as restricted to facilitating the deliberation process and acting on the basis of its outcome.

During the focus group sessions, some participants made a distinction between the national government and local governments, but most did not. We believe it is important to consider the role of not only the national government, but also the various tiers of local government, i.e. the municipalities, the provinces and umbrella bodies such as the Association of Netherlands Municipalities (VNG) and the Association of Provinces of the Netherlands (IPO).[19] Finally, the water agencies and water authorities also come under the heading 'government'.

Conclusion

To sum up: the focus group participants recognize the complexity of the radioactive waste issue and regard it primarily as a technical problem. Feedback from the focus groups indicates that the public do not feel a responsibility to act at the present time. They therefore feel that it is too early for *citizen participation*. The focus group participants see different levels of participation in decision-making

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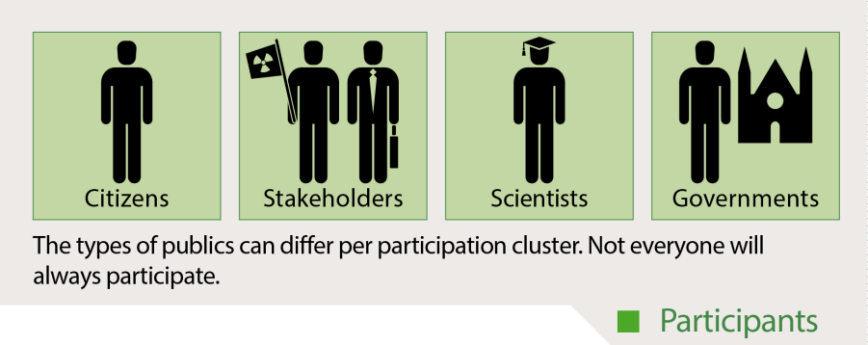
[18] Laka is a Dutch documentation and research centre for nuclear power.

[19] As explained in subsection 3.2, radioactive waste cannot be managed exclusively within the Netherlands. Consequently, it may be appropriate to involve not only the Dutch government, but also the governments of other EU member states in the decision-making process.

about long-term radioactive waste management as appropriate for the scientific community, the various tiers of government, stakeholders and the general public. The process should therefore involve the following distinct participant groups: the scientific community, the various tiers of government, stakeholders and the general public (see Figure 2), each being concerned with its own portfolio of topics.

Figure 2 The various groups involved in the decision-making process



3.1.2 Long-term radioactive waste management and the nuclear energy debate

The nuclear energy industry is the main producer of radioactive waste

The focus group participants see the nuclear energy industry as the main producer of radioactive waste. They additionally recognize the role played by medical applications in the production of such waste. Although some focus group members want the design of public participation to address the specific question of nuclear energy, most take the view that the process should relate to radioactive waste from all sources. In either case, it should be clear to participants in the decision-making process whether a decision is required regarding the long-term management of existing radioactive waste only, or regarding the management of waste produced in the future as well.

Reflection on the focus groups

The nuclear energy policy that a country pursues has implications for that country's radioactive waste debate. That is apparent in the United Kingdom and Germany, where the long-term radioactive waste management is regarded as inseparable from the production sources, such as nuclear power plants and, to a lesser extent, hospitals. There is considerably more opposition to the production of radioactive waste by the power industry than to the production of such waste by the medical sector. It is clear from the debate in the UK and Germany, and indeed in Switzerland, that the public associate radioactive waste with the production of nuclear energy (Damveld & Van den Berg, 2000). Some NGOs in those countries have made their participation in decision-making about the long-term radioactive waste management conditional upon the cessation of nuclear power production (in the foreseeable future).

In the Netherlands too, nuclear energy policy has a bearing on the radioactive waste debate. Both the research reported here and the feedback from earlier debates demonstrate that the public see the two issues as inseparable. Interdependency between the nuclear energy debate and the radioactive waste debate has impeded progress with public participation in decision-making about radioactive waste (Schroder, 2012). Box 3 outlines the course of the so-called Broad Social Debate (in Dutch: Brede Maatschappelijke Discussie or BMD): one of the main public debates organized by the Dutch government regarding energy policy in general and nuclear energy in particular. The BMD has a tangible legacy in the Netherlands. Ever since that debate, a section of the public have been very distrustful of government policy on nuclear energy, and the lack of trust has implications for the way public participation in decision-making about the long-term radioactive waste management is organized. It is important that the government is clear about the policy on nuclear energy[20].

Earlier research by CORA (2001) also found that the public's perception of the risks has a major bearing on the debate regarding the long-term radioactive waste management. Fear of radioactive waste and lack of confidence in how any waste management policy would be implemented, coupled with a negative attitude towards nuclear energy, have a significant influence on the perceived risk. That negative attitude will inevitably surface in the context of public participation in the decision-making about radioactive waste. A further obstacle to securing public participation in decision-making about the long-term radioactive waste management is that a part of the public suspects that the government will place more emphasis on the production of nuclear energy if a solution is found for the radioactive waste problem (CORA, 2001). In that respect too, the debate regarding the radioactive waste management is closely linked to the debate regarding (the future of) nuclear energy.

From our interviews with experts and stakeholders in the Netherlands and other countries it is also apparent that some important NGOs (including Greenpeace) regard decision-making about the long-term radioactive waste management as directly linked to the source of the waste. Like their counterparts in other countries, environmental NGOs in the Netherlands regard the phasing out of nuclear energy as a precondition for their involvement in decision-making about the long-term radioactive waste management.

However, the radioactive waste problem is not exclusively a product of nuclear energy production. If there were no nuclear energy production in the Netherlands, the country would still have a nuclear waste problem and would still need to find a solution to that problem. Not only would nuclear waste continue to be produced in the context of other activities, but the waste that has already been produced would still require management.

[20] Previous publications by the Rathenau Instituut (including Ganzevles & Van Est, 2011, and Ganzevles, Kets & Van Est, 2008) also stress the importance of a clear energy policy in order to secure social support for decisions regarding energy technologies.

Box 3: Radioactive waste and public participation in decision-making in the Netherlands

European Directive 2011/70/Euratom requires each EU member state to submit a national programme for the radioactive waste management to the European Commission. The programme has to include provisions explaining how the public are to be involved in the decision-making process. While that requirement may be seen as the origin of this report, the public participation that results from it will not be the first process of its kind in the Netherlands. The Dutch public has been consulted about nuclear energy and radioactive waste policy on several previous occasions.

Probably the best-known policy consultation exercise was the Broad Social Debate (in Dutch: Brede Maatschappelijke Discussie or BMD). The BMD ran from 1981 to 1983 and was concerned with energy policy, with particular emphasis on nuclear energy. The debate was set up with a view to resolving the political-governmental nuclear energy impasse that had developed in the Netherlands, partly as a result of public opposition to the use of nuclear energy. Although the BMD resulted in the government (the Lubbers administration) being advised not to build any *more* nuclear power plants, that advice was set aside by the government. At the time, many people felt that the BMD had been a pointless exercise, because its outcome had been disregarded. Indeed, leaked information indicated that the government had decided to build new nuclear power plants before the BMD had even got underway (Van Hengel, 2007). Shortly afterwards, however, in reaction to the Chernobyl disaster the government decided that there would be no additions to the existing two nuclear power plants after all.

The BMD has a tangible legacy in the Netherlands. Ever since that debate, a section of the public have been very distrustful of government policy on nuclear energy, and the lack of trust has implications for the way public participation in decision-making about the long-term radioactive waste management is organized. Another important lesson to come out of the BMD is that, when seeking to involve the public in the decision-making process, it is essential to state clearly at the outset how the conclusions of the consultation process will influence the policy ultimately adopted. There must be nothing to suggest that public participation will be used merely to legitimize decisions taken previously in another context.

Public debate regarding radioactive waste and nuclear energy did not end with the BMD. In the years since, various (local) campaign groups and consultative bodies have organized further debates regarding the disposal of radioactive waste. The possibility of interring radioactive waste in underground salt domes is an idea that has been debated widely and vigorously, for example.

3.2 Learning from public participation programmes in other countries

Important lessons can be learnt from experience gained in other countries with public participation in decision-making about radioactive waste[21], one being that trust in government is an important precondition for the realization of such participation. That particular lesson is reinforced by what happened in the Netherlands' Broad Social Debate (see Box 3). The most effective tool for reinforcing trust in government is cooperation between the national and local tiers of government regarding matters such as the course, aims and manner of participation.

United Kingdom

Over the last forty years, the processes of decision-making about radioactive waste have repeatedly floundered in the United Kingdom. In the eighties and nineties, for example, the UK was unable to decide on a suitable site for the radioactive waste management. Responsibility for choosing a location lay with NIREX (the Nuclear Industry Radioactive Waste Executive), an organization set up by the nuclear industry. Ultimately, however, the regional authorities were unwilling to license a facility at NIREX's preferred location. Among the factors that contributed to the failure to secure permission were lack of transparency and lack of public participation. It was unclear why certain decisions were taken or a particular location was selected.

In 2008, the UK's national government resumed the search for a suitable repository site, this time placing more emphasis on local citizen participation. Counties were given the opportunity to volunteer to host a permanent geological repository for radioactive waste. A partnership was formed, made up of Cumbria's county council and various borough councils, plus stakeholders such as churches and the agriculture and tourism board, which was given support by the national government to carry out research and consultations and to organize open days. In early 2013, however, the new process ultimately stalled as well. One of the tiers of government involved (Cumbria County Council) rejected the plans on account of doubts concerning the suitability of the region's geology for a permanent repository.

In April 2015, the legislation in the United Kingdom was changed to allow the national government to overrule local planning decisions. The disposal of radioactive waste is now considered to be a project of national importance, meaning that the national government can select a suitable repository site if no local authority agrees to host a facility (Department of Energy and Climate Change, 2015).

Germany

In Germany, the search for a suitable location for the radioactive waste management has similarly been going on for more than forty years. During that time, Germany's federal government has set various initiatives in motion, but has so far been unable to find a suitable location for the country's high-level radioactive waste. The possibility of disposing of such waste in a salt mine in Gorleben

[21] The conclusions presented are based on interviews carried out for this project. The organizations consulted are listed in Annex 2.

has been investigated, while mines in Asse, in the state of Nedersaksen, are amongst the sites considered for medium-level and low-level radioactive waste. The Asse mines have been used for radioactive waste storage since 1967, but in 2008 it was discovered that water had been seeping into the mines all along, creating risks (e.g. as a result of storage drums rusting).

A number of participatory programmes have been organized in Germany, with a view to identifying a suitable site for the radioactive waste management. German's Federal Ministry of the Environment established the AkEnd Committee (Arbeitskreis Auswahlverfahren Endlagerstandorte), which organized information meetings, debates and symposiums between 1999 and 2003. The committee recommended a decision-making process focusing on long-term safety, regional interests and the willingness of the regional population and independent experts to participate in the process. However, the states were unwilling to participate in the process because none of them wanted to be involved in an initiative that might lead to them being expected to accommodate radioactive waste. Consequently, AkEnd Committee's recommendation did not ultimately lead to the selection of a suitable location (Kallenbach-Herbert, 2011; Minhans and Kallenbach, 2012).

In the years that followed, the Federal Ministry of the Environment twice sought to restart dialogue with the public in the Gorleben region (via various representative groups), first launching the Forum Endlager-Dialog (FED) (2008) and later the Gorleben Dialog (2011). The Forum Endlager-Dialog was affected by the resignation of some forum members, partly because of differences of opinion and lack of clarity regarding the possible expansion of nuclear activities in Gorleben and the regulations that would provide a legal basis for exploring the options[22] (Kallenbach, 2012).

One lesson that can be learnt from the German experience is that finding a suitable location is difficult in a federal system such as Germany's, where there are several tiers of government (national, state, district and municipality), each with its own powers and electoral cycles. Since the national government announced in 2011 that nuclear energy would be phased out, dialogue regarding the selection of a location for a management facility appears to have been proceeding more smoothly. Lack of political consensus regarding the participation process remains an obstacle to arriving at a decision on the siting of a management facility that enjoys general support. In 2013, Germany's parliament passed the Repository Site Selection Act (Standortauswahlgesetz), which is intended to facilitate the process of selecting a generally acceptable location and which puts all possible locations up for consideration once more. The act appears to represent a step towards political consensus regarding the mechanism for selecting a location for radioactive waste management. However, the way that the act was drawn up has been criticized for lack of transparency, since the preparations took place largely within the political community[23].

[22] The Mines Act or the Nuclear Act: each has its own implications for any participation process or site selection process.

[23] The act's preparation was unusual, since it is usually the ministry that is responsible for the process. Environmental organizations such as Friends of the Earth and Greenpeace and local citizens' groups (e.g. in Gorleben) have criticized the process because they feel that they were not involved sufficiently.

Sweden

In Sweden, work on the creation of a permanent geological repository has started. In the lead up to a decision about the long-term radioactive waste management, municipalities were given the opportunity to put themselves forward as candidate hosts for a permanent geological repository. Discussions considered not only safety, but also job creation, compensation and local economic growth, so that the positive aspects of hosting a repository also received attention. A number of municipalities expressed an interest in accommodating a facility. The selected municipalities were places that already had nuclear power plants, meaning that local people were familiar with nuclear activities. In Sweden, the municipalities that participated in the selection process did so on a voluntary basis and had the opportunity to withdraw at any time. Another factor in the success of the public participation process identified in the course of our interviews was that NGOs were given financial support to enable them to carry out their own research and thus to make good any information disadvantage that they might have relative to governments or businesses.

Another lesson that may be drawn from the experience in Sweden and the United Kingdom (and, indeed, in Belgium) is that community acceptance of the establishment of management facilities depends largely on local circumstances. Communities that already have nuclear installations are generally less negative about permanent repositories. The main reason for that is that people who live near to nuclear power plants are likely to work there or know people who work there. They consequently recognize the economic significance of hosting a management facility.

Reflection on experience in other countries

In the countries whose experiences we investigated through our interviews, the involvement of lower tiers of government (provinces and municipalities) was an important feature of the decision-making process, but by no means self-evident. The differences between the responsibilities of national and local governments are such that clear role demarcation is required: who ultimately manages the participation process? The national government cannot easily circumvent the power of local and regional governments, even if the national government passes legislation allowing the imposition of national policy that overrides local policy.[24] A good understanding between the different tiers of government is therefore essential for the success of public participation and for arriving at a decision that commands general support.

Differences in the interests or powers of the various tiers of government can lead to inconsistent policy or friction in the decision-making process. Similar problems were highlighted by earlier research undertaken by the Rathenau Instituut into decision-making about the extraction of shale gas in the Netherlands. It was observed that (lack of) coordination amongst the central government, the provinces and the municipalities could influence public trust in the decision-making process. Public trust in the decision-making process is a prerequisite for public participation in that process (De Vries et al. 2013). That was apparent in the context of the Groningen natural gas extraction issue. The Dutch Safety Board concluded that, in the decision-making process, the national

[24] From 1 June 2008, for example, the Dutch national government regularly used the State Coordination Scheme for energy projects of national importance. Broadly speaking, that strategy was not very successful. Indeed, it often appeared to merely generate greater and more fanatical opposition (De Vries et al. 2013).

government attached greater importance to the (economic) interests involved in gas extraction than to the interests and safety of the public (OVV, 2015). The effect was to seriously undermine trust in the national government amongst affected sections of the population. The alignment of local interests (as represented by the provinces, municipalities and umbrella organizations) and national interests is a similarly important focus point in the context of the long-term radioactive waste management.

4 Radioactive waste: an ambiguous problem

In Chapter 3 we identified three important characteristics of the radioactive waste problem: the lack of public trust in the political community and the government, the general public's sense of lacking knowledge and information about the radioactive waste problem, and linkage of the radioactive waste problem to the nuclear energy debate.

A policy problem with those characteristics, which are indicative of considerable uncertainty about the available knowledge and lack of agreement regarding the applicable standards and values, is referred to as an ambiguous policy problem[25]. Ambiguous policy problems are distinct from policy problems that have clearly discernible causes and are characterized by greater concordance about the values and standards involved, and less uncertainty[26].

It is apparent from academic research that decision-making about ambiguous policy problems requires a participatory approach (see, for example, Funtowicz and Ravetz, 1993; Wynne, Gibbons et al., 1994; Hage et al., 2010). Public participation can be a valuable means of supporting decision-making in the context of problems that are characterized by considerable uncertainty, that involve a number of different interests, that bring various visions, standards and values into play and that potentially have substantial social impact. The classic decision-making model, in which the scientific community provides input for decision-making, is ineffective with such problems. When experts have a dominant role in the decision-making about an ambiguous problem, and insufficient attention is paid to the divergent values involved or to the scientific uncertainties, there is a risk of (political) impasse (Hisschemoller and Hoppe, 1996). In order to avoid or resolve such an impasse, it is necessary to draw on a wider range of experiences and insights from across the community. Furthermore, it is important to have equality amongst the participants in the decision-making progress – whether they are from the general public, the scientific community, the various tiers of government or stakeholder groups – regardless of their hierarchical status or knowledge advantage. Equality provides a basis for participants to learn from each other about the nature of the policy problem.

In subsection 4.1, we explain why the radioactive waste problem is ambiguous. It is characterized by both technical and social uncertainty. Subsection 4.2 examines the various component issues within the radioactive waste problem. Some component issues involve more uncertainty than others. In subsection 4.3, consideration is given to the long-term nature of the radioactive waste problem. There is always uncertainty about events or developments that may occur in the future and that have the potential to influence public participation in decision-making about radioactive

[25] In academic literature, such problems are also referred to as 'wicked problems' or 'unstructured problems' (Hisschemoller and Hoppe, 1996).

[26] The problem distinction referred to is applied by the International Risk Governance Council and others (Renn and Graham, 2006) when setting out how various types of risk-related problem should be addressed.

waste. In subsection 4.4, we set out the implications of the radioactive waste problem's ambiguity for design of the process of public participation in decision-making about radioactive waste.

4.1 An ambiguous problem: why and for whom?

The radioactive waste problem is characterized by social and technical uncertainties. It also involves divergent interests and outlooks, which can lead to the erosion of trust between the public, stakeholders and government. Hence, the problem is ambiguous not only for society and the government, but also for the scientific community and stakeholders. The ambiguity of the radioactive waste problem is considered in this subsection.

Technical uncertainty

Radioactive waste remains harmful for a very long time, and the remoteness of the time horizon introduces major uncertainties. One of the uncertainties is that we do not know exactly how to extrapolate the findings of experiments with relatively close time horizons (a few years to a few decades) to disposal options that need to remain effective for (extremely) long periods (thousands of years).

Uncertainties are also inherent to technological developments and scientific research. There are technical uncertainties associated with the methods currently used in the storage of radioactive waste. In Sweden, for example, there is debate regarding the storage method to be used (KBS-3). KBS-3 involves containing radioactive waste within copper and steel capsules and then disposing of the capsules in deep rock formations (granite). However, the copper capsules used to enclose the waste have been found to be less corrosion resistant than originally envisaged.

In addition to the technical uncertainties that surround the existing technologies, there are significant uncertainties associated with the development of new technologies. Those uncertainties are amplified by the fact that radioactive waste has to remain in its repository for a very long time, and the fact that a permanent solution may not be decided on for more than a hundred years – by which time disposal technologies are liable to have moved on a long way.

For example, a method known as partition and transmutation is under development, which is not yet ready for use, but increasingly appears to be viable. It involves separating the various isotopes present in radioactive waste and converting them into shorter-lived isotopes, meaning that the resulting waste would not remain hazardous for as long. The technique has so far been shown to work only on a small scale (e.g. Taebi, 2010 and Arcadis, 2013). However, the CORA report raises questions about partition and transmutation. In the Netherlands, radioactive waste is encapsulated in glass, in which state it is unsuitable for further processing (CORA, 2001; lower house of the Dutch parliament, 2002). We nevertheless believe that it is important to highlight how the development and application of such technologies – now and in the future – can expedite decision-making about the long-term radioactive waste management. That in turn has implications for the role of public participation.

The issue of technical uncertainty was raised during the focus group sessions: group members commented on the rapidity of developments in the field of science and technology. In view of the (technological) changes that have taken place over the last eighty years, focus group members are unsure what they can usefully contribute to decisions that may not be taken for another eighty years. Their input is liable to be overtaken by advances in technology. That problem is not confined to the current generation: as long as technology continues to develop, there will be uncertainty about what will be technically possible in the future.

The constant development of new technologies implies not only technical uncertainty, but also unpredictability in the course of public participation.

Social uncertainty

Radioactive waste management is a similarly ambiguous problem for many NGOs and businesses active in the field of nuclear energy. The ambiguity derives from their uncertainty regarding the policy on nuclear energy and from the divergence of their own (political) views on what that policy should be. NGOs such as Greenpeace believe that a commitment to ending nuclear energy production is needed before progress can be made towards resolution of the radioactive waste problem. The views on radioactive waste and nuclear energy held by such NGOs are quite different from those held by businesses active in the nuclear sector, which prefer to regard the radioactive waste problem as quite separate from the issue of nuclear energy production.

Limited trust in government

Decision-making is generally complicated by the lack of trust that the public and lower tiers of government potentially have in the national government. Our research indicates, for example, that the public and certain stakeholders do not really trust the national government to create a fair mechanism for public participation in decision-making about the long-term radioactive waste management. That lack of trust, fed by certain high-profile critics, can lead to public mistrust of the government in relation to decision-making about radioactive waste management. The focus group members also expressed lack of confidence that their safety concerns would be taken seriously by the national government. Some of those concerns are linked to one of the sources of long-lived radioactive waste, i.e. nuclear energy production. There is also concern about intergenerational fairness: the division of benefit and burden between different generations (Taebi, 2010). The various options for the long-term management and processing of radioactive waste differ in terms of their short-term and long-term effects, or their implications for the current generation and future generations. The interests of future generations are likely to be served best by a reversible solution, which would open the way for the correction of earlier errors and the adoption of alternative storage solutions (see e.g. Damveld and Van den Berg, 2000) and thus for future generations to make their own decisions about radioactive waste management. For the current generation, reversibility is less attractive, insofar as it may imply managing radioactive waste above ground. There is concern too about the fairness of the way in which benefits and burdens are distributed amongst various population groups. The implications of a particular policy may be different for people living (perhaps involuntarily) near to a future radioactive waste management site than for people living elsewhere: the processes of disposal or storage may cause nuisance and detract from quality of life, while the economic benefits may also exhibit geographical concentration. Issues of fairness and voluntariness are often highly emotive.

Trust may also be limited between the various tiers of government, as considered in Chapter 3. The causes a lack of trust between tiers of government include divergence in the political and other interests and outlooks that prevail at the regional and (inter)national levels. The extremely distant time horizon of the radioactive waste problem complicates matters further, because reaching long-term (international) governmental agreements and securing long-term commitment are difficult. Other countries face similar difficulties.

In the context of radioactive waste management, it is important to create trust between the various groups that will be involved in the public participation process, such as tiers of government, the general public, the scientific community and stakeholder groups. The ANVS must invest in promoting trust in the process of public participation and in the government's role in that process. Trust can exist only if the motives for public participation are clear and transparent, and if the government's actions are consistent with its stated aims (Meijboom, 2005). If people have trust in the decision-making process, they are more willing to accept technical and social uncertainty (Blankesteijn et al., 2014).

Trust is not static, but a dynamic phenomenon that requires continuous maintenance. An ongoing focus on the question of trust is therefore important. That may find expression, for example, in the form of recurrent dialogue with the public, the scientific community, stakeholder groups and tiers of government, to reflect on the subject matter and process of public participation and to make adjustments as necessary. A reflection cycle could be coordinated with evaluation of the national programme, as required by the Euratom Directive once every ten years. The importance of reflection is considered further in subsection 5.2.

4.2 Component issues within the radioactive waste problem

The radioactive waste problem is a composite problem, and decisions have yet to be made about a number of its component issues. We believe it is important to specify the component issues regarding which no formal decision has yet been taken, because this affects the demarcation of public participation.

Current government policy assumes a management option in which radioactive waste is at least retrievable (see Box 4). Definitive decisions have yet to be taken regarding the management option to be pursued – above-ground storage or underground disposal – and regarding the location of the storage facility or repository. However, the solutions discussed mostly involve underground disposal. Nor has it been decided whether the Netherlands will pursue a national solution for the long-term radioactive waste management, or seek to collaborate with other EU member states or other countries that face similar challenges.

Box 4: IBC criteria and retrievability

In the Netherlands, radioactive waste management has to satisfy a number of requirements. In this feature, we accordingly consider the IBC criteria and the retrievability requirement.

IBC criteria:
The Policy Document on Radioactive Waste assumes that radioactive waste will be stored in accordance with the criteria of isolation, control and surveillance, known as the 'IBC criteria'. The interpretation of those criteria, as explained in the 2002 Parliamentary Paper on Radioactive Waste (lower house of the Dutch parliament, 2002) is as follows:

- Isolation: radioactive waste will be stored in such a way that, under all conceivable conditions, it remains isolated from the biosphere and thus from biological systems.
- Control: government policy must be such that the quantity of radioactive waste is an important focus point. Furthermore, for each stored drum, a record must be kept of the radiation level at the surface, the amount of radioactivity contained in the drum and the origin of the waste.
- Surveillance: the favourable circumstances created at the time of the radioactive waste's initial storage, must be maintained over time. To that end, radiation must be measured adjacent to each drum, in the air of the storage buildings, on the personnel and at the boundary of the site.

Retrievability
In 1993, a cabinet document was produced, which introduced the requirement that radioactive waste must be retrievable (lower house of the Dutch parliament, 1993). The document states that application of the IBC criteria must result in the creation of the safest possible repository. Any disposal method that does not conform to the IBC criteria has to be rejected. Hence, waste must be disposed of in a retrievable manner, not only with a view to enabling reuse and relocation, but also with a view to reversibility, so that every stage of the disposal process is reversible (lower house of the Dutch parliament, 1993). A later cabinet memorandum (lower house of the Dutch parliament, 2002) defines retrievability as the assurance that the individual steps of the process can be reversed, if proved necessary, so that the process as a whole remains manageable and controllable.

One disadvantage of retrievablity s that it implies that future generations are burdened with the need to manage the radioactive waste being produced today. The cabinet policy statements express the expectation that that drawback is outweighed by the advantages that retrievability offers, such as reuse and process intervention (lower house of the Dutch parliament, 1993). In other countries too, retrievability is regarded as a key requirement for a repository.

Some of the stakeholders that we interviewed believe that the government needs to define the concept of retrievability more clearly and implement it clearly in practice.

We have identified the following component issues of long-term radioactive waste management problem: (multi)national management, management technology (technical options for long-term disposal or storage) and site selection. The reason for breaking down the problem into those component issues is that each of them requires a decision of a very different nature; the factors that

influence a decision about the siting of a radioactive waste management facility (e.g. social acceptance) are very different from those that influence a decision about what constitutes suitable geology for an underground repository. Each component issue therefore requires different public participation arrangements. The identified component issues are considered in more detail below.

(Multi)national management

The Netherlands is not the only country that needs a solution for the long-term radioactive waste management. Other countries that produce radioactive waste face similar challenges. The EU member states have agreed that each country will establish a national programme and accept ultimate responsibility for the long-term management of its own radioactive waste (Directive 2011/70/Euratom). Those requirements do not, however, exclude the possibility of collaboration, e.g. in the form of joint preparatory research or the sharing of experiences. When we refer to cooperation on the long-term radioactive waste management, we mean multinational management. Multinational management requires binding international arrangements that remain effective in the long term. It is not yet clear what implications multinational management would have for the choice of the waste management technology. Whether the Netherlands should opt for a multinational management solution is largely a political and strategic decision. A multinational management scenario is likely to imply the Netherlands accepting waste from other countries and/or exporting waste to other countries. The possibility of radioactive waste being imported to the Netherlands from elsewhere makes the international coordination and exploration of collaboration a very politically sensitive option.

Technologies for long-term management

Over the last thirty years, various research programmes have been set up in the Netherlands to explore the options for the safe long-term radioactive waste management (see Box 5 for a summary). Broadly speaking, there are three options: above ground, just below ground and deep below ground.

Underground disposal may involve housing the waste just below the surface (e.g. in concrete bunkers a few tens of metres underground) or deep in the earth's crust, e.g. in granite formations, salt deposits or layers of clay. The latter approach is known as geological disposal and has been the subject of the most research, both in the Netherlands and internationally.

With a geological disposal solution, radioactive waste is placed far from the environment inhabited by people, in drums in a repository hundreds of metres below the surface. The composition of the rocks below the surface is very important in the context of geological disposal, because of the implications for water migration and faulting. Research by CORA (2001) found that the geology of the Netherlands included a number of rock salt and clay formations suitable for geological disposal (see Feature 5). It was accordingly concluded that, in principle, underground disposal was possible in the Netherlands. No specific site was proposed, however (Slingerland, 2004). The OPERA research programme was set up to further explore the underground disposal options, in particular their safety in the long term (COVRA, 2013).

Another underground disposal option involves drilling holes down to three or four kilometres beneath the surface. The borehole option, which has been researched by OPLA, is based on the

principle that the depth of the borehole provides the necessary isolation. If the borehole is deep enough, there is no need to utilize a geological formation with isolating properties, since there is almost no risk of hydrological transmission from extreme depth to the surface. In theory, therefore, disposal in boreholes is possible in various substrata (OPLA, 1989). Since the OPLA studies, little further research into deep borehole disposal has been conducted.

Above-ground storage is also possible. One option is to continue with the existing storage system at COVRA. That would, however, imply rebuilding or adapting the storage facilities about every hundred to three hundred years (see, for example, Arcadis, 2013; CORA, 2001).[27]

There has been, and continues to be, a lot of debate regarding the studies that have explored the various radioactive waste management options. Earlier studies (see Box 5) have caused considerable commotion and triggered emotional reactions to the long-term radioactive waste management. On behalf of the Ministry of Economic Affairs, the engineering consultancy Arcadis is currently researching a number of management options, including underground and above-ground storage and disposal just below the earth's surface (Arcadis, 2013). The Arcadis research has again drawn a lot of comment. One criticism that has been made is that the exploration of possible storage methods and sites has not been broad enough (MER Committee, 2013) or explicit enough (WISE, 2013).

Box 5: Research into options for the disposal of radioactive waste in the Netherlands

Since the first Policy Document on Radioactive Waste was presented to the lower house of the Dutch parliament in 1984, various studies have been conducted into possible disposal methods.

In 1984, the government set up the Committee on Above-ground Disposal (OPLA), to prepare the way for the disposal of radioactive waste in salt domes (lower house of the Dutch parliament, 2002). In line with the Policy Document on Radioactive Waste, the ILONA (Integrated National Nuclear Waste Research) Policy Commission asked OPLA to investigate the scope for disposing of radioactive waste in salt formations in the Netherlands. The conclusion of the first phase of the research was that a repository for radioactive waste created in salt formations below the surface of the Netherlands was in principle both feasible and safe in the long term.[28]

In 1995, the government created the Radioactive Waste Disposal Committee (CORA) (lower house of the Dutch parliament, 2002). The new committee's remit was to investigate above-ground and underground retrievable disposal methods suitable for various geologies (salt and clay formations). The conclusion of the report *Retrievable disposal: a viable option?* was that long-term above-

[27] In Scotland, the government has stated that the long-term storage of high-level radioactive waste should be close to existing nuclear facilities, such as nuclear power plants. The underground storage of radioactive waste is not supported as a management option (The Scottish Government, 2011).

[28] In 1993, the cabinet decided that the recoverable storage of high-level radioactive waste in salt formations (as investigated by the OPLA programme) was not a realistic option. The physical properties of salt, which would consolidate around the waste once the disposal facility was sealed, would make recovery very difficult (Parliamentary Paper 23163 *Disposal of waste deep below ground*).

ground storage, underground disposal in salt and underground disposal in clay were all technically feasible (CORA, 2001). With regard to retrievable disposal, CORA concluded that it could be desirable to have a reserve storage option, in case it ever proved necessary to recover radioactive waste. In that eventuality, the waste would need to be stored somewhere else, at least temporarily. CORA accordingly recommended a combination of above-ground and underground disposal (CORA, 2001). A supporting study into the social dimensions found that debate regarding the disposal of radioactive waste was influenced by negative attitudes to nuclear energy (Damveld and Van den Berg, 2000).

More recently, various further research programmes have been organized. Since 2011, in the context of COVRA's Permanent Radioactive Waste Repository Research Programme (OPERA), various researchers have studied the underground disposal of radioactive waste (COVRA, 2013). OPERA includes the ENGAGED project and the RESTAC project. The ENGAGED[29] project was set up to produce recommendations as to how stakeholders can be actively involved in the implementation of a geological disposal programme for radioactive waste in the Netherlands. The RESTAC[30] project is concerned with the retrievability of radioactive waste in the context of Dutch waste policy (COVRA, 2013). In addition, Arcadis was commissioned by the government to explore the long-term options for the radioactive waste management (Arcadis, 2013).

Site selection

In a densely populated country like the Netherlands, any proposal regarding the siting of a radioactive waste management facility is likely to meet opposition. Even studies into technologies of waste management can provoke considerable reaction. The selection of a particular management technology and site selection are closely linked: one location may be preferred for an underground repository, for example, but another for an above-ground storage facility. Site selection for underground disposal is influenced by e.g. geological criteria, which are much less relevant in site selection for above-ground storage. Furthermore, a decision to use salt domes or clay formations automatically rules out parts of the country where such formations are not found. Candidate clay formations and salt domes were identified at an earlier stage. The influence can also work in the other direction: fierce opposition to the use of a particular location can imply the side-lining of the management option possible at that location. In either case, the support of local people will have a major bearing on the ultimate site selection.

Research undertaken in other countries can also cause disquiet. In Belgium, the National Institute for Radioactive Waste and Enriched Nuclear Fuels (NIRAS) is currently looking into the geological disposal of high-level radioactive waste. Test drillings will have to provide information about the possibility of disposal in the Boom Clay (NIRAS, 2014). The location of the boreholes (Postel, in the municipality of Mol) is very close to Dutch border towns such as Bergeijk. Consequently, concern about the Belgian plans has been expressed by Dutch municipalities in the region and by the water

[29] ENGAGED stands for End repository Network Geared towards Actor Groups involvement and Effective Decision-making.
[30] RESTAC stands for REtrievability and STAged Closure.

company Brabant Water (interview with Van der Meijden, Brabant Water, 2015). Dutch and Belgian groundwater reserves are directly linked, so that any leaks from a future repository in Belgium could affect the quality of the drinking water in the Netherlands.

4.3 The time line: uncertain and changeable

COVRA has stated that it has enough space to safely store the total amount of radioactive waste that the Netherlands is expected to produce in the next hundred years (COVRA, 2010). Given the context in which this report is written, the public participation process could in theory run for a hundred years, therefore. With such a potentially distant horizon, it is currently very difficult to define a precise time line for public participation. Over the course of a century, all sorts of events could occur, shedding new light on any decision about radioactive waste and influencing the course of public participation. In subsection 4.1, we described how technological developments can influence the course of public participation. In this subsection we consider three other factors with a potential bearing on the radioactive waste debate and the role of public participation.

Disasters and incidents

Disasters and incidents, in the Netherlands or elsewhere, can influence the speed of the public participation process and the timing of decision-making about long-term waste management. Because radioactive waste is often associated with the production of nuclear energy, incidents at nuclear power plants are particularly likely to have such effects. Examples include the explosion of one of the four reactors at the Chernobyl nuclear power plant in 1986, and the failure of the generators at the Fukushima nuclear power plant due to the serious earthquake and tsunami that hit Japan in 2011. The fear and emotion engendered by such incidents impact on the energy policy debate and, within that debate, on the role of nuclear energy. For example, the Fukushima disaster has accelerated Germany's decision to phase out nuclear energy. As previously noted, a decision to phase out or retain nuclear energy can influence the process of public participation. Incidents involving or connected with radioactive waste (e.g. accidents during the transportation of such waste, a terrorist attack or the use of nuclear weapons) have the potential to shape the process as well.

Geopolitical tensions

The world is currently experiencing geopolitical tensions, which could lead to changes in national and European energy policy. Geopolitical tensions that increase the EU's energy dependency (e.g. the current dependency on Russia and the Middle East), could necessitate the radical realignment of energy policy. That might, for example, lead to renewed interest in nuclear energy. The associated debate would influence the course of public participation in decision-making about the long-term radioactive waste management.

Governmental changes

Trust in the European Union is no longer self-evident. Immediately before the European Parliament elections, a study found that nearly two thirds of people in the EU did not feel that their voices are heard in Brussels. Immediately after the elections, the proportion fell (Eurobarometer, 2014). Nevertheless, bolstering trust in the European Union will remain a significant challenge in the years ahead. We do not know how the situation will develop in the future, but if trust in the European

Union is further narrowed, this could have implications for the prospect of multinational management or for the content of the Netherlands' national programme.

Governmental changes can also take place at the national level. Political instability and short-lived cabinets can affect energy policy and therefore decision-making about the long-term radioactive waste management.

The Rathenau Institute advises the ANVS to take account of the possibility of unexpected developments (see Figure 3). The public participation process may ultimately need to be longer or shorter in duration than envisaged beforehand, or to start sooner or later than envisaged beforehand. In Chapter 5, we consider the potential implications of unexpected developments for the course of public participation.

Figure 3 Potential unexpected developments with implications for public participation

4.4 The design of public participation

The design of public participation covers both the subject matter and the process of participation. The design of public participation has already been reflected on and investigated in various ways. Last year, for example, a series of meetings were held to discuss how decision-making about long-term waste management should be organized, e.g. in the context of the ENGAGED project (see also Box 5) or the European Commission's E-TRACK project. At the local level too, politicians and community groups have organized meetings to consider the long-term radioactive waste management. In the interest of public participation, it is important to continue promoting such meetings and projects, so that the public are properly informed and able to form opinions.

Successful realization of public participation in decision-making about radioactive waste depends on a number of important conditions being satisfied. First, the general public, the various tiers of government, the scientific community and stakeholder groups must be willing to participate. The design of the public participation process is determined by the subject matter. A second condition is therefore that the way in which public participation is organized (e.g. how relevant participants are selected) needs to be tailored to the concerning topic or component issue. Third, effective

supervision of public participation is important to arrive at a decision about the long-term radioactive waste management .

Willingness to participate

Public participation is useful only if the general public, the scientific community, stakeholder groups and tiers of government are willing to participate. Willingness to participate depends on a variety of factors, including the perceived relevance and urgency of the matter to be decided. If, for example, the matter is not perceived to be very urgent, people are less likely to invest their time and/or knowledge. From the focus group sessions, it appears that getting people to commit to the process is a challenge. There is a mismatch between the extent to which people identify with the problem and its perceived urgency (see subsection 3.1). The NGOs we spoke to made reference to that mismatch.

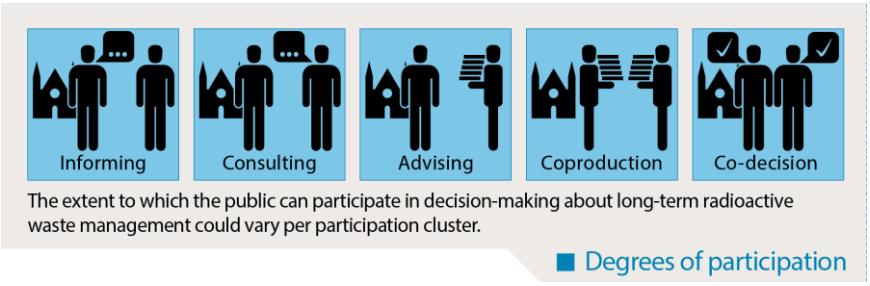
Willingness to participate also depends on the extent to which people support the process of public participation. It is therefore important to jointly investigate who is willing or unwilling to participate, why, when and how. This report is a first general contribution to that investigation. Another important requirement is that the public participation model should be discussed with the general public, stakeholder groups, the scientific community and the various tiers of government. In the context of our study, we have taken steps in that direction by putting our preliminary ideas to two public focus groups and discussing them in stakeholder interviews. Hence, our reflection was organized on a participatory basis. Reflection and debate regarding the process of participation must continue, however; continuous attention is required.

Another subject of continuous reflection should be the ground rules for the participation process. The focus group members have already defined a number of ground rules for public participation (see Box 2), including open and transparent communication about the process and clarity about how the outcomes of the participation process will be used. The results of reflection can serve as inspiration for further elaboration of public participation..

Issue-based participation clusters

Not only the process of participation, but also the subject matter or 'agenda' of participation requires clarification. Participation in decision-making about each of the component issues – (multi)national management, management technologies and location choice (as discussed in subsection 4.2) – should ideally be tailored to the component issue in question. After all, participation can take many forms, from merely keeping the public informed about policy decisions to giving the public partial or even full authority to make decisions. Annex 3 contains a 'participation ladder': a visualization of the various possible degrees of participation. It is important to clarify what degree of participation is envisaged. Participation in decision-making about the various component issues may therefore vary in terms of the degree of participation (ranging from informative to co-decisive) and the actors involved in participation (the scientific community, stakeholder groups, tiers of government, the general public), as illustrated in Figure 4.

Figure 4 Various degrees of participation



We therefore propose the use of *issue-based participation clusters*. By organizing participation on the basis of issue clusters, the participation arrangements can be tailored to the issues. So, for example, the degree of participation, the method of participation and associated participants of decision-making about site selection may differ from those associated with decision-making about management technologies. Where the site selection is concerned, the general public and lower tiers of government might be given a co-decisive role, while in the management technologies cluster that role might be given to the scientific community. The outcome of participation in decision-making about management technologies may be the identification of geological disposal as the preferred option, for instance. Variations in the timing of participation may also be appropriate: the point at which public participation is desirable about management technologies is not necessarily the best point to involve the public in participation about the site selection. Although a precise sequence cannot be put forward at this stage, public participation about the various component issues does not have to be synchronous. We recommend setting up a participation cluster for each component issue of the radioactive waste problem and carefully matching the participants, the timing and the manner of participation to the characteristics of that cluster. In view of the interlinked nature of the component issues, it is important that the design of each participation cluster does not exclude any potential outcome.

In subsection 4.4, the point was made that the various (studies into) management technologies are closely linked to the site selection. In subsection 3.1.2, we also demonstrated that nuclear energy and radioactive waste are inseparable issues. Openness to and involvement in debate regarding nuclear energy is therefore advisable.

There is an additional participation cluster, highlighted by the focus groups and others, in which continuous reflection is the focus point. It is important to reflect on the subject matter of public participation (for example: is the participation agenda still adequate?), the participation process (for example: does the participation design still enjoy support?) and the ethics of the problem (for example: how can our society deal with intergenerational problems?). We propose establishing a separate participation cluster devoted to reflection, so that continuous reflection on the public participation arrangements is itself organized on a participatory basis. In other words, reflection on the subject matter and procedural design of public participation and on the wider, ethical dimension of the problem should be a collective process. As indicated earlier, collective reflection on such

matters promotes willingness to participate. The subject of reflection is considered in more detail in subsection 5.2.

Supervision of the public participation process

It is important that people understand who is in control of the public participation process and who will make the final decision.[31] Until 1 January 2015, responsibility for activities in the Netherlands involving the use of radioactivity or the production of radioactive waste lay with various ministries. The Ministry of Economic Affairs was responsible for administration of the Nuclear Energy Act and for licensing. The Department of Nuclear Safety, Security, Safeguards and Radiation Protection (an agency of the Ministry of Infrastructure and the Environment) was responsible for monitoring the safety of nuclear facilities, the transportation and storage of radioactive material and compliance with the associated legislation and regulations. The Programme Directorate for Nuclear Facilities and Safety (NIV) at the Ministry of Economic Affairs was responsible for preparing legislation and policy regarding radioactive waste and other matters. To reduce fragmentation in the way tasks and responsibilities are allocated in the field of nuclear safety and radiological protection, the Authority for Nuclear Safety and Radiological Protection (ANVS) was established in 2015. The ANVS is to be an independent governmental organization responsible to the Ministry of Infrastructure and the Environment. Its tasks and powers cover nuclear safety and radiological protection, plus the associated emergency readiness and protection (Chapter 3, subsection 3, Nuclear Energy Act).

Our research shows that, although the national government has an essential part to play in the participation process, there is little trust in the national government on this topic. That raises several questions: What role should the government play in the participation process? What organization should act as coordinator/administrator, organizing and coordinating public participation? The central government necessarily has a facilitating role to play. It is, after all, the body that bears the financial burden and responsibility for the implementation of public participation and for the ultimate decision-making. With regard to the coordinating and administrative role, the focus group members, the Dutch and international interviewees, earlier studies[32] and certain critical documents[33] all suggest that the following conditions should be attached to the process controller function: political-administrative and industrial independence, openness, reliability and transparency.

- *Political-administrative independence* implies the process coordinator/administrator being as free as possible from any interest in the outcome of the decision-making process. *Industrial independence* is also important, as emphasized by CORA's final report (CORA, 2001).

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[31] We assume a governance approach focusing on the alignment and coordination of various actors' activities with a view to securing a public objective (Hoppe, 2011). In this case, the public objective is a decision about radioactive waste, arrived at by a process of public participation. In this context, 'governance' implies striving to organize and guide a decision-making process, in which the government, stakeholders, the scientific community and the public are involved.

[32] For example: 'Recoverable Disposal: a viable option? Research into the possibility of the recoverable storage of radioactive waste in the Netherlands', Radioactive Waste Disposal Committee (CORA, 2001).

[33] For example: 'Commentary on the government report "Project plan for exploratory research into the options for the long-term management of radioactive waste and spent nuclear fuels": no basis for meaningful debate and research', (WISE, 2013) and 'Nuclear waste and nuclear ethics: social and ethical aspects of the recoverable storage of nuclear waste', (Damveld and Van den Berg, 2000).

Industrial independence implies the administrator being able to identify the interests of stakeholders, the public, tiers of government and the scientific community, without attaching more importance to the one than the other.

- *Openness*[34] implies the process coordinator/administrator being open to signals from the outside world. While public participation is in progress, stakeholders, citizens, government bodies and scientists may signal their views regarding matters such as the manner or timing of participation. For example, certain participants (e.g. action groups) may at a given point withdraw from further participation due to differences of opinion regarding the process or the debate. Another possibility is that new parties and groupings emerge that wish to participate in the decision-making process. Any such developments may be signals that the participation process requires recalibration or even revision.

- *Reliability* implies reliable behaviour on the part of the process coordinator/administrator. Reliable behaviour is behaviour that is consistent with the expectations of the parties that need to have trust in the person or organization in question. More specifically, the administrator must be clear and transparent about its motives in relation to public participation and must behave accordingly.

- *Transparency* implies the process of public participation being clear and transparent. It must be clear to all participants how the process will work, what the background to and parameters of public participation are, who the participants are, how long the process will last, and how the outcome will be used. In addition, it is very important that information is provided before, during and after the public participation process.

The focus groups highlighted the need for better information about radioactive waste (e.g. the quantities produced, the management possibilities, the current government policy is) and about future government plans regarding radioactive waste. One example of how information might be made available is a periodic newsletter regarding the progress of public participation .

[34] This condition was put forward during consultations with stakeholders in the context of the ENGAGED project (Mozaffarian (ed.), 2015).

5 The course of public participation about long term radioactive waste management

At this stage, it is difficult to define a starting point or duration for the process of public participation in decision-making about long term radioactive waste management. Indeed, one may reasonably assert that the process has already begun. Various parties have undertaken research into public participation in decision-making about long-term radioactive waste management (see subsection 4.4), which may be regarded as a form of participation. We have also had the Broad Social Debate, various discussion evenings and other forms of organized response (see Box 3), so participation in decision-making is not new to this field. Although those initiatives differed in the degree and design of participation (giving rise to criticism), they serve to illustrate both that participation itself is not new and that continuous reflection on the participation process is important.

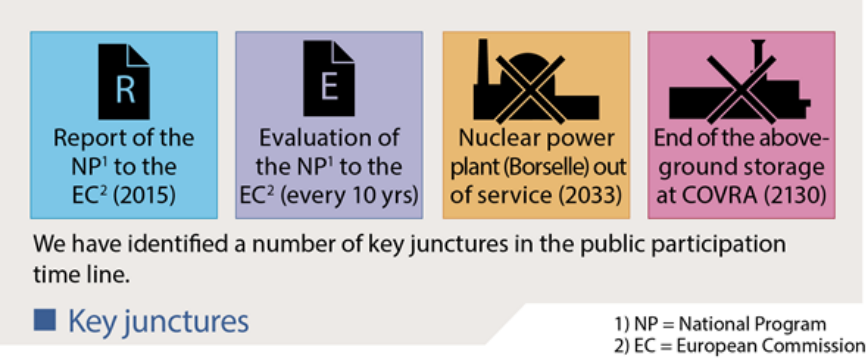
To secure a structured realization of public participation in the context of the Dutch national programme, it is useful at this stage to identify a number of key junctures in the public participation time line. Those junctures are considered in subsection 5.1. It is also important that, all along the time line, there is regular reflection on the process and agenda of public participation. The need for reflection is considered in subsection 5.2. In subsection 5.3, an infographic is presented, illustrating the interrelationships between the various factors that play a role in public participation in decision-making about the long-term radioactive waste management.

5.1 Key junctures in the public participation time line

With a view to securing the structured realization of public participation in the context of the Dutch national programme, we have identified a number of key junctures in the public participation time line, (see Figure 5). They are:

- The year 2130, which COVRA and the national government have adopted as the end date for temporary above-ground storage of radioactive waste at COVRA (subsection 5.1.1)
- The year 2033, when the nuclear power plant at Borssele is to be taken out of service (subsection 5.1.2)
- The year 2025 (and every tenth year thereafter), when periodic evaluation reports on the Dutch national programme have to be submitted to the European Commission (subsection 5.1.3)

Figure 5 Predictable events and reporting dates



5.1.1 The end of the above-ground storage at COVRA

It is no easier to specify an end point for public participation than to specify a starting point. However, we do know that the government and COVRA envisage that decision-making about the long-term radioactive waste management will span a period of a minimum of hundred years. The current government is assuming that Dutch radioactive waste will be safely stored at COVRA until the permanent repository becomes operational, no later than 2130. A decision about the long-term radioactive waste management must therefore be reached before that date. The process may however be shortened by external events or technological developments, as described in subsection 4.3.

5.1.2 Closure of the nuclear power plant at Borssele

Another significant forthcoming event that is already known about is due to take place in 2033. That is when the nuclear power plant at Borssele is to be taken out of service (Rijksoverheid, 2013). The plant will then be decommissioned.[35] It is likely that before 2033 there will be a public and political debate about the value of and need for nuclear energy and – in the wake of that debate – about the problem of high-level radioactive waste. We expect that this may lead to social involvement.

It is pertinent, therefore, to briefly consider two scenarios and their implications for willingness to participate in the process of decision-making about the long-term radioactive waste management. The first scenario is that the closure of the nuclear power plant at Borssele marks the end of nuclear energy production in the Netherlands. If so, no more high-level radioactive waste will be produced in the context of nuclear energy production. The radioactive waste created by the decommissioning of the nuclear power plant will of course still require storage, however. The second scenario is that plans are developed for nuclear energy to remain a component of the Netherlands's energy supply

[35] In theory, the nuclear power plant at Borssele might close before 2033, e.g. if its continued operation ceased to be economically viable or was judged to represent an unacceptable safety risk.

mix. Any initiative to build a new nuclear power plant will need to come from private investors.[36] In that scenario, it will be necessary to manage the radioactive waste produced at the new power plant(s), in addition to that created by the decommissioning of Borssele. In the first scenario, parties opposed to nuclear energy production will be more willing to participate in decision-making about radioactive waste (a number of them having indicated that their participation is dependent on a commitment to phase out nuclear energy). Conversely, the second scenario is likely to create challenges in terms of the willingness of some stakeholders and citizens to participate in the process.

High-level radioactive waste is also produced by the research reactors in Petten and Delft. Although research reactors are less controversial than nuclear power plants, new plans for the reactors may also trigger political and social debate. For example, a new research reactor, the Pallas reactor, is planned for Petten and may be operational by 2023 (Ministry of Economic Affairs, 2013).

In 2025, the ANVS is required to evaluate the progress of the Dutch national programme and make its second progress report to the European Commission. That would appear to be an appropriate juncture to move to the next stage in the process of designing the issue-based participation clusters (subject matter, who, when?) and to report on the progress made. Between 2025 and 2033, the ANVS can then develop the design further. That timetable would allow for utilization of the social involvement associated with closure of the nuclear power plant at Borssele.

As indicated earlier, trust in the national government and willingness to participate are preconditions for successful public participation. Given that trust in the national government is currently at a low level, the period up to 2025 affords an opportunity to foster more trust in the national government and in public participation. That will require a collective process, in which the approach to public participation is considered and proposals are discussed with (lower tiers of) government, stakeholders, the scientific community and the general public (see also subsection 6.1.3).

5.1.3 The periodic evaluation and reporting cycle

The Euratom Directive requires member states to evaluate and recalibrate their national programmes every ten years from 2015. Every three years, member states must also report to the European Commission on the implementation of their national programmes (Euratom, Article 14, 2011).[37] As indicated in the previous subsection, it is envisaged that the ANVS will report on the *design* of the participation clusters in the first national programme evaluation and recalibration year, i.e. 2025. From 2035, it will be important to additionally evaluate and report on the *progress* of the participation clusters.

[36] In theory, private investors could take the initiative to build a new plant before 2033.
[37] The Directive states that once every three years members must report to the European Commission on implementation of their national programmes, and that once every ten years member states must organize self-evaluations of their national programmes and their implementation.

5.2 Reflection on public participation

Reflection on public participation is important because future developments may impact on the issue of waste management in ways that cannot currently be predicted.[38] Reflection on public participation implies periodically evaluating the process and agenda of public participation and making adjustments as necessary.[39] It is also important to reflect on the ethical and administrative aspects of the radioactive waste problem in the long term.

Reflection should involve all parties participating in the process, e.g. as part of the three-year reporting cycle provided for in the Directive. Stakeholders should be consulted from the outset, when working out the parameters for reflection. Early consultation is vital in the context of fostering community trust in public participation and thus willingness to participate. It is advisable to start planning the reflection cycle immediately, and certainly before 2025 (the next evaluation year specified in the European Commission timetable). In the following subsections, consideration is given in turn to reflection on the process (5.2.1), the agenda (5.2.2) and the ethical aspects (5.2.3).

5.2.1 Reflection on the process

Reflection on the process should focus on the organization and design of public participation. Consideration should accordingly be given to questions such as: Who is or should be participating? Is there sufficient willingness to participate? Are the ground rules for public participation still adequate?

As indicated in subsection 4.3, unexpected developments may occur, such as incidents at nuclear power plants. A disaster at Borssele, for example, might lead to the nuclear power plant being closed earlier than scheduled. Such developments could make it appropriate to accelerate or shorten the public participation process. In the interest of an appropriate response to any such event, it is also important to periodically reflect on the process and make adjustments where necessary.

It is advisable to synchronize the cycle of reflection involving the general public, the scientific community, stakeholders and tiers of government with the European Commission's reporting cycle (see subsection 5.1.3). That would facilitate the continuous evaluation and refinement of the approach to public participation and the restatement of the motives for the process. Such a methodology is vital for fostering trust in public participation and thus increasing the general willingness to participate.

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[38] The need for reflection was highlighted by, for example, the interviews and focus group sessions that we organized on the basis of a draft report.

[39] In subsection 4.4, we argued that, for trust in public participation and willingness to participate, it is important that both the agenda and the process enjoy general acceptance and support. We also indicated that public participation requires continuous reflection, because maintenance of the willingness to participate by means of periodic recalibration is essential in the context of a prolonged public participation process.

5.2.2 Reflection on the agenda (knowledge assurance)

It is necessary to periodically reflect on the agenda for public participation (component issues: (multi)national management, management technologies an site selection) because social or technological insight into the radioactive waste problem is liable to move on during the course of the process, e.g. in the light of developments in other countries. It is therefore important that, throughout the public participation process, knowledge of all of the component issues is kept up to date. There are two reasons for that. First, for the manageability and transparency of the public participation process, the grounds on which the government makes decisions must be traceable. Second, (specialist) knowledge regarding radioactive waste needs to be maintained in an accessible form, so that it remains available to future generations. Thus, knowledge assurance can perform both an informative function (can a decision be made on the basis of the existing knowledge?) and an agenda-setting function (on what matters is research still required?). We propose that knowledge assurance should exhibit three essential features: a participatory knowledge agenda, information that supports decision-making and long-term continuity.

A participatory knowledge agenda

Scientists in various disciplines are currently carrying out research that may be relevant for long-term radioactive waste management. In addition, NGOs, action groups, involved citizens and businesses in the nuclear industry may also have useful information at their disposal. The first of our essential features is therefore that knowledge should be placed on the agenda on a completely public and participatory basis. Hence, the knowledge agenda will be based on information sources originating from the citizens, scientists in various disciplines, stakeholders and (lower tiers of) government. An example of such an information source is an earlier study of the composition of underground geological formations in the Netherlands (by CORA). Box 4 highlights a number of other previous studies that could already add to the knowledge agenda.

One focus point is the fact that merely doing research (i.e. working on the knowledge agenda) can meet with resistance and trigger debate. For example, research into the feasibility of using a given site for radioactive waste management will inevitably become a topic of discussion. That was illustrated recently when trial boreholes were sunk in Belgium, close to the Dutch border, to establish whether the area was suitable for geological disposal. People in adjacent parts of the Netherlands quickly started expressing concern about the possibility of underground disposal nearby. A similar pattern of events was seen when the possibility of disposing of radioactive waste in salt domes in the north of the Netherlands was investigated by the OPLA Committee in the eighties. Again, the study prompted considerable debate (e.g. Damveld, 2010). Other research can cause community disquiet as well. Consequently, the construction of a knowledge agenda (subject matter) and the participation process must be viewed in association.

It is also important not to lose sight of the fact that not all questions concerning long-term radioactive waste management can be answered using scientific research (Blankesteijn et al., 2014). That is typical of ambiguous problems. Normative questions cannot be answered by science, although science can serve an informative function in relation to such questions. Even some technical issues are difficult to resolve with science. What is the best way to 'communicate' with

future generations, for example? How can the current generation make it clear to future generations where and how radioactive waste is stored (Damveld, 2015)? In the USA, one of the techniques used in the storage of radioactive waste at the Waste Isolation Pilot Plant (WIPP) is the application of indelible pictograms,[40] but there is ongoing debate as to what markings and language are sufficiently immune to the effects of time. We have no way of knowing how present-day warnings may be interpreted by people who encounter them thousands of years from now.

Information that supports decision-making

The second essential feature of knowledge assurance is that the knowledge involved is relevant to and always available for decision-making. The participatory approach to the knowledge agenda contributes to realization of this feature, by ensuring that available knowledge remains up to date and that any knowledge lacunae are placed on the agenda.

Long-term continuity

The third essential feature of knowledge assurance is that the organization that manages the knowledge agenda is able to monitor the knowledge, place it on the agenda, update it and make it available to the wider world, continuously over a long period of time.

Realization of the three essential features requires the responsibility of an independent, external organization, such as a university or an independent knowledge centre not affiliated to any organization with an administrative, political or industrial interest in the field.

5.2.3 Ethical reflection

From the focus group sessions and interviews, it is apparent that participants also attach importance to the ethical aspects of the problem. There is a need to consider the consequences of certain choices that we make and how we can justify those choices to ourselves. That is partly because long-term radioactive waste management is an intergenerational problem, which is 'bequeathed' to later generations, and because the waste will require management for a very long time, creating considerable administrative challenges (long-term stewardship).

Ethical reflection involves reflecting on the values that we as a society consider important, and on their role in public participation in decision-making about long-term radioactive waste management. Themes such as intergenerational fairness and the division of benefit and burden between different generations are relevant in that regard.

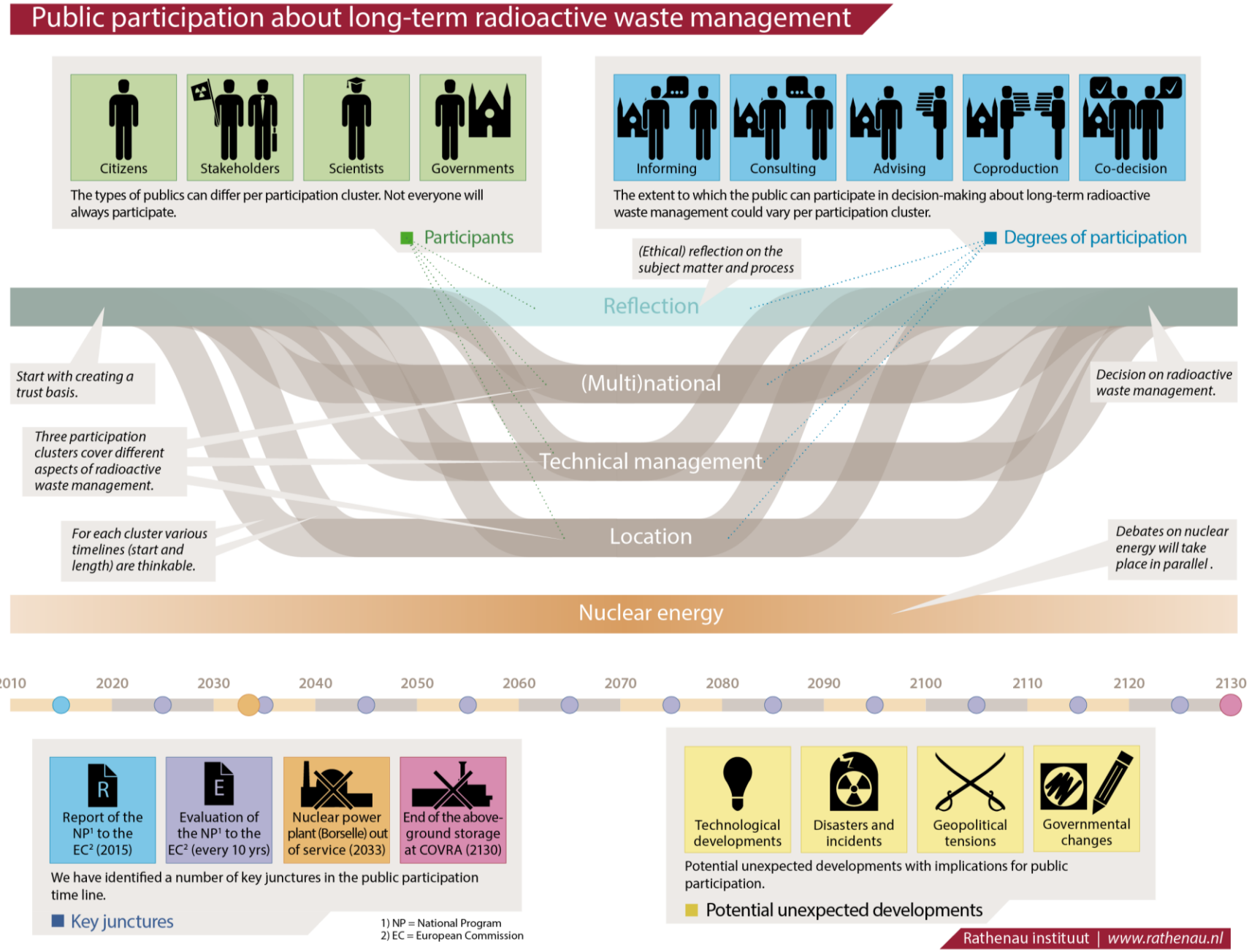
[40] http://www.wipp.energy.gov/picsprog/articles/WIPP%20Exhibit%20Message%20to%2012,000%20A_D.htm.

5.3 Interrelationships between factors

The following infographic illustrates the various factors relevant to public participation in decision-making about the long-term radioactive waste management and their interrelationships. The infographic is a composite illustration, made up of Figures 2, 3, 4, and 5, as presented in the preceding chapters.

The figure shows that there are various participants, who can participate to various degrees. The participants and the degree of participation vary across the participation clusters, which are represented by the four bars. Reflection is an ongoing participation cluster, because reflection takes place continuously. The participation clusters linked to the three component issues do not have fixed starting points or end points; they are therefore represented by 'fluctuating' bars. Because the nuclear energy debate is inseparably linked to public participation in decision-making about long-term radioactive waste management, it is illustrated in a separate bar. In that field, debate may become more heated as participation progresses.

The participation clusters are illustrated for the period from the present day to 2130. The duration of public participation is influenced by policy cycles and by the closure of nuclear reactors ('predictable events'), as well as by (geo)political or technological developments ('unexpected developments').


Public participation about long-term radioactive waste management
Citizens
Stakeholders
Scientists
Governments
The types of publics can differ per participation cluster. Not everyone will always participate.
Participants
Informing
Consulting
Advising
Coproduction
Co-decision
The extent to which the public can participate in decision-making about long-term radioactive waste management could vary per participation cluster.
Degrees of participation
(Ethical) reflection on the subject matter and process
Reflection
Start with creating a trust basis.
(Multi)national
Decision on radioactive waste management.
Three participation clusters cover different aspects of radioactive waste management.
Technical management
For each cluster various timelines (start and length) are thinkable.
Location
Debates on nuclear energy will take place in parallel .
Nuclear energy
2010 2020 2030 2040 2050 2060 2070 2080 2090 2100 2110 2120 2130
R
Report of the NP[1] to the EC[2] (2015)
E
Evaluation of the NP[1] to the EC[2] (every 10 yrs)
Nuclear power plant (Borselle) out of service (2033)
End of the above-ground storage at COVRA (2130)
We have identified a number of key junctures in the public participation time line.
Key junctures
1) NP = National Program
2) EC = European Commission
Technological developments
Disasters and incidents
Geopolitical tensions
Governmental changes
Potential unexpected developments with implications for public participation.
Potential unexpected developments
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6 Core message, summary and recommendations

6.1 Core message

The core message of our vision of public participation in decision-making about the long-term radioactive waste management is as follows:

> **Each EU member state is obliged to formulate a national programme for the long-term radioactive waste management. Public participation is part of the national programme. Because the long-term radioactive waste management is a complex intergenerational problem, public participation is both necessary and challenging. It is not sufficient to involve only the general public: good public participation also involves lower tiers of government, stakeholders and the scientific community. Moreover, trust in central government and collective willingness to participate are essential preconditions for successful public participation. Steps must therefore be taken to ensure that those conditions are met before proceeding further.**

6.2 Summary

Our society produces radioactive waste of all levels (low-level, medium-level and high-level radioactive waste). Radioactive waste is unwanted material that emits ionizing radiation. Prolonged exposure to such radiation is harmful to people and the environment. It is therefore important that radioactive waste is safely collected, processed and stored, so that it cannot escape into the environment.

Directive 2011/70/Euratom requires the Dutch government to submit a national programme for decision-making about radioactive waste to the European Commission by August 2015. The programme must include information setting out how the public will be given the opportunity to participate in the decision-making process.

In a political-administrative sense, the long-term radioactive waste management is an extremely challenging problem. It is challenging because of its intergenerational dimension (decisions about long-term radioactive waste management have implications for many future generations), because of its multi-faceted nature and because it is characterized by divergent interests and conflicting political outlooks. Such 'ambiguous problems', as they are known, are best resolved on the basis of public participation.

On the basis of Directive 2011/70/Euratom, public participation was initially interpreted as the involvement of ordinary citizens. However, the ambiguous nature of the problem means that it is not sufficient to involve only the general public in decision-making about the long-term radioactive waste management. Good public participation also involves lower tiers of government, stakeholders

and the scientific community. Successful public participation in decision-making about long-term radioactive waste management additionally depends on organizing a reliable and honest process, which does not exclude any potential outcome. In the establishment of such a process, it is necessary to begin by endeavouring to build up trust and willingness to participate. With a view to bolstering trust and willingness to participate, collective consideration of how public participation can best be organized should begin immediately. The ANVS should also establish a cycle of continuous reflection on the subject matter and procedural design of public participation, as well as on the ethical aspects of the management problem in the long term.

We have identified three component issues of long-term radioactive waste management problem: (multi)national management, management technologies and site selection. For each component issue, we propose creating a participation cluster. The various clusters may differ from each other in terms of the parties involved, the degree of participation and duration of the process. Reflection on the participation clusters is essential, not only with a view to bolstering trust, but also as a basis for adjustment of the clusters where necessary. The reflection should itself be organized on a participatory basis. We accordingly propose that reflection should be a participation cluster in its own right. Because the radioactive waste problem and the nuclear energy debate are inseparably linked, we recommend being open to discussion.

It is not possible to define a starting point or end point for public participation, because the time line is uncertain. The time line is susceptible to influence in the form of technological developments, incidents with radioactive waste or nuclear power plants, geopolitical tensions or administrative changes at the national or European level.

Nevertheless, a number of key junctures can be identified. First, we regard 2033 as an important year for public participation in decision-making about long-term radioactive waste management. That is when the nuclear power plant at Borssele will be taken out of service. The plant's scheduled closure will make the radioactive waste debate more topical. Willingness to participate is consequently likely to be high at that point in time. The year 2025 will also be a key juncture. That is the final opportunity prior to closure of the Borssele plant for the ANVS to report the findings of its evaluation of the Dutch national programme to the European Commission. In the vision presented here, 2025 is therefore a key juncture, which is also highlighted in our recommendations.

Until 2025, the prospects for good public participation involving ordinary citizens do not appear strong. We recommend that, in the period up to 2025, the ANVS focuses mainly on preparing for public participation. To that end and with participation of various stakeholders (the scientific community, lower tiers of government, businesses and NGOs) the ANVS is investigating views on this vision of public participation and the associated agenda (component issues). That exercise is expected to contribute to restoration of trust in government and thus to willingness to participate in decision-making about the long-term radioactive waste management. It may be advantageous to align such preparatory activities with the cycle for reporting on the progress of the Dutch national programme to the European Commission.

6.3 Recommendations

On the basis of our research, we make six recommendations. Our recommendations are intended for the Authority for Nuclear Safety and Radiological Protection (ANVS), to support development of the Dutch national programme. The six recommendations are set out below. Supporting information is provided in the earlier chapters of this report.

1. Be clear about the role of nuclear energy
In the context of public participation, it is important to clearly state the relationship between nuclear energy and radioactive waste, since decision-making about long-term radioactive waste management and about nuclear energy are inseparably linked. Without an explicit, shared vision of the role of nuclear energy in the nation's future energy supply, public participation would be largely ineffective.

2. Tailor public participation by using issue-based participation clusters
Long-term radioactive waste management is an ambiguous problem. Its three component issues (multinational management, management technologies and site selection) may suit various levels of public participation (from informative to co-decisive) and various forms of public participation. The design of each participation cluster therefore requires individual attention. The site selection is a particularly sensitive participation cluster, which will in practice need to be integrated with the other clusters: research into a particular form of management technologies will have implications for the site selection, for example.

3. Participation should involve not only the general public, but also the various tiers of government, stakeholders and the scientific community
Participation in decision-making about an ambiguous problem such as the long-term radioactive waste management should not be restricted to the general public. The general public themselves agree that participation should also include the various tiers of government, stakeholders and the scientific community.

4. It is important to promote trust in national government and willingness to participate
Trust in national government and willingness to participate are essential preconditions for effective public participation. Where long-term radioactive waste management is concerned, trust in the national government is not currently strong. The development of a public participation model whose subject matter and procedural design enjoys widespread support, is the best way of bolstering trust and willingness to participate. To that end, regular reflection is required (see recommendation 5).

5. Start the process of reflection immediately and adjust public participation when necessary
Regular reflection on the subject matter and procedural design of the public participation process, and on its ethical aspects, is important for the development and retention of trust and willingness to participate. Reflection provides a basis for public participation in decision-making about the long-term radioactive waste management to adapt it to changing circumstances at home and abroad. In that context, we recommend at least the following three measures:

- **Development of a shared plan for public participation**
  The various perspectives on public participation should be explored, e.g. by discussing the underlying vision[41] with stakeholders, the scientific community, the various tiers of government and the general public, with a view to arriving at a shared plan for designing the public participation model. The ANVS could start work on this measure in the next year.

- **Tailoring of participation clusters**
  The subject matter and procedural design of each participation cluster should be developed individually. That can be done on a participatory basis, as soon as the shared plan has been formulated.

- **Periodic reflection**
  Periodic reflection on the shared plan, on the subject matter and procedural design of the participation clusters, and on the social and technical-scientific context of the long-term radioactive waste management is desirable. The periodic reflection should be repeated until 2025, when the ANVS is required to submit an evaluation of the Dutch national programme to the European Commission. It is recommendable that the ANVS synchronizes this reflection with the national programme progress reporting cycle[42] called for by the Directive. After 2025, the focus of reflection should shift to the progress and outcomes of the various participation clusters.

7. The design and implementation of the various participation clusters should adhere to certain ground rules

It is advisable that the further design and implementation of the various participation clusters should adhere to certain ground rules (see Box 2), relating to matters such as communication, information provision, demarcation and transparency. It is also important to demonstrate that public participation is taken seriously and not used as a mechanism for 'rubber stamping' decisions that have already been made. It is also advisable that the public participation process should be managed by a body that is independent in political-administrative and commercial terms (insofar as that is possible) and that is open, reliable and transparent.

[41] The draft version of this vision has already been discussed with a small group of stakeholders, scientists, government officials and representatives of the general public.

[42] The Directive requires that a report on implementation of the national programme be submitted to the European Commission once every three years, and that the member states perform self-evaluations of their national programmes and their implementation at least once every ten years.

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Appendix 1: Project description

Radioactive waste is hazardous because it emits radiation. Most radioactive waste is a by-product of nuclear reactors, but such waste is also produced in hospitals, research laboratories and industrial settings. In the Netherlands, COVRA is responsible for the storage of radioactive waste until 2130.

In November 2013, the Programme Directorate for Nuclear Facilities and Safety (NIV) at the Ministry of Economic Affairs asked the Rathenau Institute to formulate a vision of public participation in the national radioactive waste management programme over the hundred-year management period. In January 2015, responsibility for overseeing the project passed to the Authority for Nuclear Safety and Radiological Protection (ANVS).

The request was prompted by Directive 2011/70/Euratom, which requires each EU member state to submit a national programme to the European Commission by August 2015. The Directive also states that, subject to national law and international obligations, the public must be given the opportunity to participate in the process of decision-making about the long-term management of spent nuclear fuel and radioactive waste.

The commission yielded the following products:

1. A vision of public participation in the Dutch national programme. The vision describes a successful national level participation project, ultimately resulting in a joint process of decision-making about the long-term radioactive waste management.
2. This vision is made up of the following elements:
   - The cycle for reporting to the European Commission on progress with implementation of the policy set out in the national programme
   - Indicators or criteria for determining when public participation is necessary and should be organized
   - Parameters for a successful participation programme leading to decision-making about the long-term radioactive waste management
   - Pitfalls and risks to the success of the participation programmes

The Rathenau Institute attaches great value to public participation as a means of actively involving citizens in decision-making. In the context of complex and controversial issues, such as the management of nuclear waste, public participation is the standard means of obtaining a good picture of the various views held by the public, and of the underlying arguments. The point of departure is that the citizen does not begin the process without any relevant views. The citizen will not share his or her independent vision of a sensitive theme such as nuclear waste in a way that is untouched by the social context or interests.

In the context of this report, 'the public' is a broad concept, encompassing not only ordinary citizens, but also other stakeholders and environmental groups. Public participation cannot exclude certain

themes or groups. If it is to promote trust, public participation must allow participants to provide input. We have concerned ourselves mainly with the process of public participation: the design of public participation in decision-making about the radioactive waste management is therefore the central subject. This project does not consider the matters to be decided, such as the selection of possible radioactive waste management sites or management technologies.

Methodology

The project was divided into a number of phases, each characterized by its own research methods. The various phases were:

- Phase 1: Development of a vision
  - Environmental analysis: literature study (participation in general and participation in certain countries) and in-depth interviews with stakeholders and experts from other countries
  - Participation in decision-making about the design of the public participation process: focus groups
  - Completion of the vision document: on the basis of the environmental analysis and focus groups

- Phase 2: Discussion of the vision document

- Phase 3: Finalization of the input for the EC

Phase 1: Development of a vision

We began the environmental analysis with a literature study, which served to identify the crucial aspects for the development of a vision of public participation.

We additionally considered comparable situations in other EU member states in order to learn from countries that have already started programmes of participation in decision-making about the radioactive waste management. For practical reasons, we have concentrated on a small number of EU member states. We confined our enquiries to EU member states because we were interested in the experience of countries that must comply with the same directive as the Netherlands, and must therefore establish a national programme for the radioactive waste management. The countries we selected were Sweden, Belgium, Germany and the United Kingdom. A brief preliminary analysis and discussions with the ministry indicated that in those countries we would encounter public participation programmes that varied considerably in terms of duration, form, stakeholder involvement, design, political involvement and communication. We identified suitable interviewees in various ways, including liaison with the technology assessment organizations (with which we have close ties) in the relevant countries.

For our in-depth interviews, we selected a variety of stakeholders in each country, including the national government (ministries), municipalities and/or provinces and NGOs and/or critical experts. The interviews were geared to establishing the motivations for and thinking about public participation in the relevant country. The interviews took place at the interviewees' offices and were guided by a topic list drawn up on the basis of the earlier literature study. As well as interviewing

stakeholders from the four other EU member states, we undertook additional interviews with representatives of two NGOs in the Netherlands, namely Greenpeace and WISE Nederland.

In addition to the literature study and in-depth interviews, our vision of public participation has been developed using focus groups. Focus groups are useful both for exploring the substance of the theme and for developing a more detailed picture of the process of participation. The focus group members were also invited to actively reflect on suitable forms of participation for the longer term. In the focus group sessions, we established what information the public need in order to form an opinion about nuclear waste, and what role citizens envisage themselves playing in decision-making in this field. The aim of the focus group sessions was to obtain insight into the factors that citizens regard as important in relation to (the design of) public participation in decision-making about the radioactive waste management. Four focus group sessions were held, each involving seven or eight Dutch citizens. The participants were selected on the basis of educational level (high or low) and region (urban or rural). The recruitment and selection of focus group members, as well as the practical organization of and reporting on the sessions was undertaken by TNS Nipo.

Phase 2: Discussion of the vision document
The feedback from the focus groups shaped phase 2 of the project. Discussion of our draft vision document with stakeholders, citizens, government officials and scientists proved very important for the development of trust in the approach. The draft document was discussed with:

- Hamid Mozaffarian (ECN)
- Behnam Taebi (TU Delft)
- Herman Damveld
- Leo van de Vate (TNO)
- Frank van der Meijden (Alderman at the Municipality of Bergeijk, VNG)
- Debby Wimmers (Province of Drenthe)
- Rob Eijsink (VEWIN)
- Niels Aten (Province of North Brabant)
- Roel Teeuwen (Ministry of Infrastructure and the Environment)
- Mirjam Post (Ministry of Infrastructure and the Environment)

The document was additionally discussed with a number of ordinary citizens in the context of further focus group sessions.

Phase 3: Finalization of the input for the EC
In the final phase, we drew up the definitive version of our vision document, to serve as input for the Dutch national programme to be submitted to the European Commission. Part of the finalization process was drawing lessons from phase 2: feedback from the focus groups and interviews led to revisions and refinements to the vision document.

Role of the steering committee

The main reason for setting up a steering committee was that, from the in-depth interviews, it became apparent that the success of public participation depended on quality assurance and on involving a wide group of experts in the early stages of the process.

The steering committee's role was to advise the Rathenau Institute's project management on the design and contents of the project components, on the line of argumentation to be followed and on the political and administrative relevance. We attach great importance to the questions, criticism and objections to (elements of) the line of argumentation and contents that the steering committee members provided. Nevertheless, it is the Rathenau Institute that is responsible for the contents of its projects. The members of the steering committee are neither individually nor collectively responsible for the contents of Rathenau Institute projects.

Rathenau Institute steering committees are generally pluriform in their composition. Members are representatives of NGOs and relevant businesses, experts and political or governmental stakeholders. In addition, a steering committee is normally chaired by a Rathenau Institute board member. The members of the steering committee for this project were as follows:

- Hans Codée, former Director of COVRA
- Peer de Rijk, Director of WISE Nederland
- Pieter Leroy, Professor of Environment and Policy at Radboud University, Nijmegen
- Anne Bergmans, Guest Professor of Sociology at the University of Antwerp
- Barto Piersma, Programme Director of Nuclear Installations and Safety, Ministry of Economic Affairs (until 1 January 2015)
- Jan van den Heuvel, Director of the Authority for Nuclear Safety and Radiological Protection (ANVS) (from 1 January 2015)
- Hans Droge, Rathenau Institute board member
- Huub Rakhorst, CEO of URENCO

Appendix 2: Interviewed organizations (December 2013 – March 2014)

United Kingdom

- Office for Nuclear Development – UK Department of Energy and Climate Change (Departmental Head, Managing Radioactive Waste Safely and Head of Engagement, Geological Disposal Facility)
- Nuclear Legacy Advisory Forum (Co-Director)
- Greenpeace (scientist / Director)

Sweden

- Swedish Radiation Safety Authority (Departmental Head, Disposal of Radioactive Waste)
- Swedish National Council for Nuclear Waste (Director)
- MKG – Swedish NGO Office for Nuclear Waste Review (Director)
- Municipality of Osthammar

Belgium

- University of Antwerp (Professor)
- NIRAS (spokesperson)

Germany

- Oko Institut (Departmental Head, Nuclear Engineering and Facility Safety)
- Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Departmental Head, Site Selection and Radioactive Waste Management)
- Niedersächsisches Ministerium für Umwelt, Energie und Klimaschutz

Netherlands

- WISE (Director)
- Greenpeace (Campaign Leader, Climate and Energy)
- COVRA (Director)

Appendix 3: Participation ladder

Tabel 2 Participation ladder and the role of the participant [43]

Information	Consultation	Advice	Coproduction	(Co-)decision	Direct control
Politicians and government set the agenda for decision-making and keep stakeholders informed. Stakeholders are not given the opportunity to contribute to policy development.	Politicians and government largely set the agenda, but work with stakeholders as discussion partners in the development of policy. The political community is not bound by the outcome of the discussions.	Politicians and government set the agenda in principle, but give stakeholders the opportunity to highlight problems and formulate solutions. The stakeholders' input has a meaningful influence on the development of policy. The political community is in principle bound by the outcome of the discussions, but reserves the right to make a final decision that departs from that outcome (subject to explanation).	Politicians, government and stakeholders collectively set the agenda and collectively seek solutions. The political community is bound by the outcome of the discussions, which is reflected in the final decision.	Politicians and government leave policy development and decision-making to stakeholders, with the government playing an advisory role. The political community adopts the outcome after testing it against predefined parameters.	Groups take the initiative to establish and maintain facilities and exercise direct control over those processes. Politicians and government are not involved.
Participant's role: information recipient	Participant's role: discussion partner	Participant's role: advisor	Participant's role: co-producer	Participant's role: co-decision-maker	

[43] Source: Institute for Political Participation (Stress in Interaction. Institute for Political Participation).

Who was Rathenau?

The Rathenau Instituut is named after Professor G.W. Rathenau (1911-1989), who was successively professor of experimental physics at the University of Amsterdam, director of the Philips Physics Laboratory in Eindhoven, and a member of the Scientific Advisory Council on Government Policy. He achieved national fame as chairman of the commission formed in 1978 to investigate the societal implications of micro-electronics. One of the commission's recommendations was that there should be ongoing and systematic monitoring of the societal significance of all technological advances. Rathenau's activities led to the foundation of the Netherlands Organization for Technology Assessment (NOTA) in 1986. In 1994 this organization was renamed 'the Rathenau Instituut'.

Het Rathenau Instituut stimuleert de publieke en politieke meningsvorming over wetenschap en technologie. Daartoe doet het instituut onderzoek naar de organisatie en ontwikkeling van het wetenschapssysteem, publiceert het over maatschappelijke effecten van nieuwe technologieën, en organiseert het debatten over vraagstukken en dilemma's op het gebied van wetenschap en technologie.

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