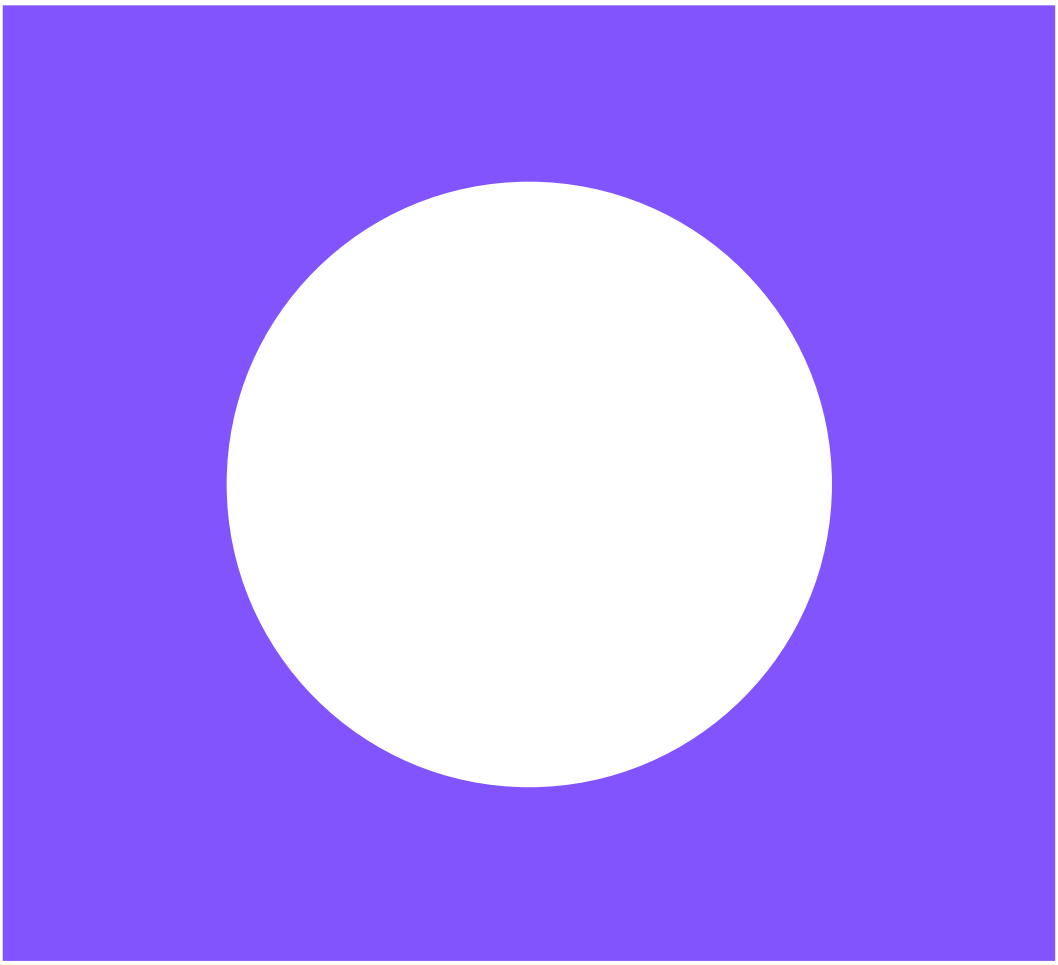
MOTT MACDONALD



An SEA for the Dutch National Programme on Radioactive Waste and Spent Fuel

English Translation of the SEA Environmental Report Summary

February 2025

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Mott MacDonald
House Modernes
Lange Viestraat 2B
3511 BK Utrecht
The Netherlands

mottmac.com/netherlands

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February 2025

Registered in Arnhem, The Netherlands
no. 30199525.

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Cover Letter

Dear Sir or Madam,

As requested by the Dutch Ministry of Infrastructure and Water Management, the Non-Technical Summary of the Strategic Environmental Assessment (SEA) Environmental Report for the National Programme on Radioactive Waste and Spent Fuel (NPRA) has been translated to English. The main body of the SEA Environmental Report has remained in Dutch. In case of any discrepancies, the Dutch text prevails

Yours faithfully,

Mott MacDonald
House Modernes
Lange Viestraat 2B
3511BK Utrecht,
The Netherlands
Mottmac.com/netherlands

Executive summary

Ionising radiation widely occurs within our society from a variety of activities, ranging from nuclear energy to medical purposes. Nuclear energy generation is a widely recognised source of radioactive waste, and waste can be produced by 'classic' nuclear power plants or new technologies such as Small Modular Reactors (SMRs). However, the production of radioactive waste occurs from a much wider range of activities than the nuclear power sector alone. Radioactivity is also involved in many industrial processes, for example to sterilise food or to assess the quality of materials.

In the Netherlands, people most frequently encounter radiation from its use in medical applications, such as diagnostic imaging or medical treatments, which also generate radioactive waste. Additionally, there is naturally occurring radioactive material, which is found for example, during the extraction of oil and gas and the use of geothermal installations. This natural radioactivity is concentrated, resulting in radioactive waste, albeit at a low level of radioactivity.

Therefore, even without (new) nuclear power plants, radioactive waste is produced in the Netherlands. The various types of radioactive waste generated by these important applications must be carefully and safely managed.

The European Directive 2011/70/EURATOM requires each member state to update and revise a national programme for the safe management of radioactive waste and spent fuel, at least every ten years. Based on this directive, the Netherlands published its first national programme for radioactive waste and spent fuel (*Nationaal Programma Radioactief Afval en verbruikte splijtstoffen* (NPRA)) in 2016. This NPRA is now being updated for the period 2025-2035.

This document presents the English summary of the Strategic Environmental Assessment (SEA) Environmental Report that has been prepared for the NPRA. The SEA outlines the environmental effects of the policies in the NPRA and compares them with realistic alternatives and seeks to identify key environmental risks and opportunities.

The National Programme for Radioactive Waste 2025-2035

The goal of the NPRA is to provide safe management of radioactive waste and spent fuel in the Netherlands. This includes:

- Spent fuel from nuclear reactors (as defined in the Dutch Fissionable Materials, Ores and Nuclear Installations Decree);
- Radioactive waste (as defined in the Dutch Basic Safety Standards for Radiation Protection Decree), for example:
  - Radioactive waste from the decommissioning of installations with activated or contaminated components;
  - Radioactive waste from any remediation of sites with radioactive contamination;
  - Naturally occurring radioactive materials (NORM) waste, for example from the extraction of oil and gas and geothermal energy;
  - Depleted uranium and other residues from the enrichment of natural uranium stored at COVRA (centralised radioactive waste management and storage site); and
  - Radioactive waste specifically authorised for release to landfills or incineration.

The policies for radioactive waste and spent fuel must ensure safe management of existing waste. Additionally, the policies reflect known activity in other policy areas which generate waste, such as the ongoing use of nuclear energy or the production of medical isotopes.

The Ministry of Infrastructure and Water Management is also looking ahead to be able to respond in a timely manner to potential future developments which may have notable impacts on the generation of radioactive waste. Current considerations include the nuclear ambitions of the Schoof Cabinet, which aims to keep the Borssele nuclear power plant open, and the construction of up to four nuclear power plants, including the possibilities for several small reactors. These are expected to affect the volume and composition of radioactive waste in the Netherlands after the period covered by the NPRA (i.e. 2025-2035). New nuclear power plants have not yet been confirmed and as a result have not been incorporated into the NPRA policies. Given the developments in the nuclear sector are uncertain at the time of writing and may significantly change in the near future, a new NPRA will be prepared in 2030, rather than waiting until 2035.

Principles of the NPRA

The policies concerning the management of radioactive waste are based on the following principles, which were also included in the NPRA 2016-2024. These are:

- Safe management of radioactive waste, now and in the future;
- No unreasonable burdens for future generations;
- Minimising the generation of radioactive waste, both in volume and radioactivity; and
- The waste generator bears the cost of managing radioactive waste.

New NPRA Policies

The policies for radioactive waste and spent fuel, as included in the NPRA 2016-2024, will largely continue in the NPRA 2025-2035. Some policies have been updated and supplemented where necessary. This includes reprocessing, registration of NORM waste, and classification of waste.

Outlook

The NPRA provides a brief outlook on future developments. Given the current dynamics in the nuclear sector and their implications for the composition and volume of waste, the NPRA is to be updated early in 2030. The accompanying SEA will also be updated at that time. A robust approach for radioactive waste management can only be determined after a decision has been made on the proposed new nuclear power plants, such as the type of reactor. COVRA has indicated that, based on current expectations for the period of this NPRA, it has more than sufficient storage capacity.

The Requirement for an SEA

The Ministry of Infrastructure and Water Management has prepared an SEA for the NPRA. The Ministry decided on an SEA because it identifies the potential environmental effects, opportunities and mitigation for the policies in the draft NPRA before a final decision is made. An SEA was selected instead of an Environmental Impact Assessment (EIA) because the NPRA is a strategic national plan, whereas an EIA is applicable for individual projects which are further progressed in terms of design and location. The SEA consequently includes a high-level assessment of potential impacts, rather than detailed project design measures.

Contents of this SEA

This SEA for the NPRA contains information on various environmental aspects, with special attention on radiation protection. There are 11 themes assessed within the SEA, which are: radiation protection, biodiversity, water, soil, air, health, climate adaptation, resources, assets and infrastructure, socioeconomic aspects, and landscape and heritage. Additionally, measures are proposed to avoid, control, and/or mitigate any significant adverse effects.

This SEA considers the individual effects of each proposed policy, as well as the combined effects of the policies within a programme. This is important because the policies within a programme can amplify or mitigate each other's environmental effects when they occur simultaneously. By following the SEA process, key risks and opportunities for the entire programme can be identified.

The SEA for the NPRA contains the following components:

- The environmental effects of the individual policies.
- The combined environmental effects of the preferred NPRA and two alternative programmes. This includes the environmental effects when all policies within a programme are in effect simultaneously.
- The cumulative effects consider the interaction of the preferred and alternative programmes with external factors, such as other national plans and cross-border effects.
- Possible environmental effects related to calamities and disasters.

Alternative Policies

For some of the policies in the NPRA, realistic alternative policies have been developed to enable a comparison of the environmental effects. When formulating these alternative policies, their feasibility and desirability for this renewed NPRA was considered. This is further described in paragraph 2.5 of the main SEA Environmental Report. An overview of the policy areas with the existing and possible alternative policies is presented in Table 0.1.

The Preferred NPRA and the Alternative Programmes

As part of the plan assessment, two alternative programmes were developed to compare the environmental effects of the preferred plan with those of possible alternatives.

A preferred NPRA has been prepared by the Ministry of Infrastructure and Water Management. This programme consists solely of existing policies and was the programme that the Ministry of Infrastructure and Water Management intended to implement at the start of this SEA.

Alternative 1 is an alternative programme based on the policies with the most favourable environmental effects. For this, the existing policies and possible alternative policies were first individually assessed for environmental effects based on the 11 SEA themes. Where there was no alternative policy for consideration, the existing policy was included.

Alternative 2 is an alternative programme based on the NPRA principle of 'no unreasonable burdens on future generations'. In Alternative 2, policies were selected considering not only environmental effects (including protection against radioactivity) but also financial burdens, public acceptance and support, and (inter)national benefits. For this, the existing and possible alternative policies were first individually assessed on environmental effects, prior to further review and workshops to identify those with a lower future burden.

In practice, the policy composition of Alternatives 1 and 2 show little difference. This is due to the fact that, according to current projections, there are few developments in waste management during the period of this NPRA. Additionally, there are many uncertainties regarding developments in the Dutch nuclear sector that affect the amount of waste beyond the period of this NPRA (e.g. the possible construction of new nuclear power plants). An overview of which policy is selected for which programme is visually represented in Table 0.1, where a green checkmark indicates that the policy is included in the respective programme.

Policies OS1b and G1b were not selected in any of the programmes because they cause relatively more adverse environmental effects than OS1a and G1a, respectively. For more information on how the programmes were composed, see paragraph 7.1 of the main report.

Table 0.1: Description of the policies (grouped) in the preferred NPRA and in Alternatives 1 and 2.

		Preferred NPRA	Alternative 1	Alternative 2
Policy Area: Storage of Radioactive Waste				
C1. Storage of radioactive waste at COVRA requiring a permit, excluding specifically released radioactive waste.	Existing	☑	☑	☑
C2. High activity sources are returned to the manufacturer or supplier of the source as much as possible, or otherwise to a recognised collection service.	Existing	☑	☑	☑
C3. Central storage of radioactive hospital waste at COVRA with a half-life of more than 100 days. If the half-life is less than 100 days, local decay storage is possible for a maximum duration of 2 years.	Existing	☑	☑	☑
Policy Area: Reprocessing of Spent Fuel				
OS1a. Preference for reprocessing of fissile materials in France will remain in place after 2033, until 2050.	Existing	☑	☑	☑
OS1b. Fissile materials will be reprocessed until 2033 due to current contracts. After 2033, fissile materials will not be reprocessed, and spent fuel will be stored directly at COVRA.	Possible Alternative	-	-	-
Policy Area: Capacity Management of COVRA and Landfills				
CM1a. There is no current reporting obligation to support the estimation of storage capacity at COVRA and landfill sites.	Existing	☑	-	-
CM1b. Reporting obligation for COVRA and operators of landfills for radioactive waste. Structured registration of waste products at COVRA and the landfills, in which consideration is given to the handling of these products, as a prerequisite for the development of minimisation strategies.	Possible Alternative	-	☑	☑
Policy Area: Landfill Capacity for Radioactive Waste				
N1a. Radioactive waste requiring registration or radioactive waste with an authorisation for specific release may be sent to designated landfills.	Existing	☑	-	-
N1b. One central location for the disposal of radioactive waste requiring registration or with an authorisation for specific release.	Possible Alternative	-	-	☑
N1c. Explore the use of landfills that could theoretically receive radioactive waste requiring registration or with an authorisation for specific release, but do not yet do so.	Possible Alternative	-	☑	-
IM1a. There is currently no import/export ban on the transfer of NORM waste for disposal.	Existing	☑	-	-
IM1b. An import ban on the transfer of NORM waste to the Netherlands for disposal.	Possible Alternative	-	☑	☑
Policy Area: Geological Disposal				
G1a. All radioactive waste goes to deep geological final disposal.	Existing	☑	☑	☑
G1b. The (long-lived) low- and intermediate-level radioactive waste is stored in a shallow final repository. The high-level radioactive waste is sent to a deep final repository.	Possible Alternative	-	-	-

Methodology for Determining the Environmental Effects

An assessment framework was used to systematically determine the environmental effects of the various policies and programmes across 11 themes:

- Radiation protection,
- Biodiversity,
- Water,
- Soil,
- Air,
- Health,
- Climate adaptation,
- Resources,
- Assets & infrastructure,
- Socioeconomic aspects, and
- Landscape & heritage.

See paragraph 4.1 of the main SEA Environmental Report for more information on the SEA themes. An example of the assessment framework for the 'radiation protection' theme is shown below in Table 0.2.

For each SEA theme, indicators and typical datasets were identified prior to the assessment. These indicators consider various aspects of the theme. For the theme 'radiation protection', for example, this includes the amount of radioactive waste produced or stored, and changes to safe containment. The impacts of each policy on the indicators are assessed as part of the SEA.

Table 0.2: The assessment framework for the SEA-theme 'Radiation protection'

Strategic EIA Theme	Indicators	Example Datasets	Impact Scale		Description of Impact
1. Radiation protection: *Possible effects of NPRA on safe containment of radioactive waste.*	• Effects on the safe containment and disposal of radioactive waste? • Effects on the amounts of radioactive waste generated or stored? • Effects on radioactive waste management infrastructure to meet future demands, or burdens on future generations?	• Capacity of radioactive waste storage facilities • Volumes of radioactive waste	**++**	Major Positive	Substantial increase in the safe containment of radioactive waste. Substantial reduction in the volume of radioactive waste. Substantially futureproof the long-term management of radioactive waste.
			+	Minor Positive	Safe containment of radioactive waste. Minor reduction in the volume of radioactive waste. Futureproof the management of radioactive waste in the short-term or medium-term.
			0	Neutral	No effects on safe containment of radioactive waste.
			-	Minor Negative	Potential minor reduction in the safe containment of radioactive waste. Minor increase in the volume of radioactive waste.
			--	Major Negative	Substantial or likely reduction in the safe containment of radioactive waste. Substantial increase in the volume of radioactive waste.
			?	Uncertain	From the level of information available, the effect is uncertain.

Datasets, such as the storage capacity at COVRA or at landfills, are used to provide insight into these indicators. The indicators and datasets have been determined for each of the themes to ensure that the same factors are considered in each policy assessment.

The assessment framework also includes a five-point scale to indicate the severity of the environmental effects. The scale ranges from major/minor positive to major/minor negative effects, with the additional possibility of neutral effects. The description of this five-point scale is also documented (see Table 0.2) to ensure that the outcomes of the environmental impact assessment are presented in a consistent manner. Each impact score is assigned a colour code to make it easy to visually interpret the results.

When an assessment shows both positive and negative effects based on different indicators for one theme, both effects are reported and do not cancel each other out. This ensures that the full range of risks and opportunities is presented for each assessment. Additionally, risk areas requiring further mitigation, recommendations, or opportunities for environmental improvement are identified. Where there are uncertainties in the assessment, this is described and indicated with a "?" in the impact score.

By using the assessment framework, the policies proposed within the NPRA can be compared with each other as a consistent scale is used for each SEA theme. Similarly, the plan-level effects of the preferred and alternative programmes can be compared. However, it should be noted that it is not possible to prioritise, offset or compare different themes within an individual policy. See Chapter 4 of the main SEA Environmental Report for more information.

The Reference Situation

The SEA is undertaken based on a reference situation which compares the policies and programmes against a scenario without these policies in place. The reference situation for an SEA is typically the current situation with autonomous development (i.e. expected future changes that would occur regardless of the new plan). However, the preferred NPRA 2025-2035 is a continuation of the existing policies in the 2016 NPRA. This means that the typical reference situation would already include the NPRA's environmental impacts in the reference situation, and the impacts of the NPRA 2025-2035 would appear neutral by comparison.

The existing policies have ongoing environmental effects that the Ministry of Infrastructure and Water Management wants to gain insight into, so that improvements and mitigation can be proposed for the new NPRA. Additionally, it is a requirement of an SEA to compare the preferred activity against a reference in which the activity is not undertaken.

To determine the environmental effects of the NPRA, a theoretical situation is taken as the reference situation. This is the environmental status in the Netherlands at the start of this NPRA with autonomous development, but without the continuation of the NPRA policies. This allows the environmental effects to be determined both for the continuation of the existing policies and/or implementing new policies. These can then be considered together to identify the environmental risks and opportunities arising from the preferred NPRA as a whole.

Assessment Periods of the NPRA

The renewed NPRA covers a period of ten years (2025-2035). A distinction is made between the environmental effects over the first half (2025-2030) and the second half of this period (2030-2035), with the latter also considering the period beyond 2035 for as long as the policy remains in effect.

For any existing policies, activity generally continues in a similar manner to current operations. For the potential new policies, these must first be developed and/or implemented, while the current policy remains in place. It is therefore assumed that the first half of the NPRA (2025-2030) is needed for the implementation of a new policy or, if relevant, for any construction prior to operation. The environmental effects of the alternative policy in operation are represented in the second period. A comparison can then be made between existing and potential alternative policies, with a focus on impacts in the second half of the NPRA.

Trends in the Production of Radioactive Waste

Radioactive residues and waste can arise from various activities. This SEA assumes that the following current nuclear installations will continue to produce radioactive waste:

- The Borssele nuclear power plant generates a stable amount of high-level radioactive waste (HLW) and intermediate- and low-level radioactive waste (ILW and LLW) that is stored at COVRA. COVRA's inventory report considers a ten-year extension of the Borssele plant's lifespan. The impact of this lifespan extension after 2033 has a limited impact on the waste inventory for the ten-year period of the NPRA.
- The High Flux Reactor (HFR) in Petten produces medical isotopes, generating radioactive waste (HLW and ILW/LLW) that is stored at COVRA. The new PALLAS reactor is expected to be operational in 2028 and will replace the HFR. A stable amount of radioactive waste is expected in the coming ten-year period. The expected amount of radioactive waste from the new PALLAS reactor is in line with that of the HFR.
- The former nuclear power plant in Dodewaard has been out of operation since 1997 and is in long-term safe enclosure, with decommissioning planned for 2045. The radioactive waste resulting from this has no impact on the current NPRA.
- Urenco operates a nuclear installation in Almelo where low-enriched uranium is produced. Part of the depleted uranium is converted into solid uranium oxide (U_3O_8) abroad and then stored as radioactive waste at COVRA. Additionally, secondary or operational waste is also generated. This waste is classified as ILW/LLW. This activity is expected to result in a stable increase in radioactive waste.

Additionally, there are activities in the Netherlands that produce NORM waste, such as pigment production, steel production, geothermal energy, or oil and gas production. These activities generate radioactive waste requiring registration, or radioactive waste that can be disposed of at designated landfills under specific release conditions.

For the first half of the NPRA, the production rate of radioactive waste is broadly stable. Towards the end of the NPRA and the period thereafter, the nuclear sector in the Netherlands is likely to develop further. This will lead to a possible increase in the production of radioactive waste for the period after 2035.

The Potential Environmental Effects of the NPRA

The environmental effects of the preferred NPRA are compared against the theoretical reference situation by means of the SEA assessment framework. The potential environmental effects of the policies in the preferred NPRA over the first half (2025-2030) and second half (2030-2035) of the period are presented in Table 0.3 and Table 0.4, respectively (see below). These tables also report the 'combined effects' (bottom row in the tables) for the combination of policies in the preferred NPRA for each SEA theme. This combined environmental effect is determined by using the assessment framework. The policies regarding geological disposal are not included in this assessment due to the very different timeline. For the assessment of geological disposal, refer to paragraph 6.5 of the main SEA Environmental Report.

Table 0.3: Potential environmental effects of the preferred NPRA for the period 2025-2030.

	Radiation Protection	Biodiversity	Water	Soil	Air	Health	Climate Adaptation	Resources	Assets & Infrastructure	Socio-economic	Landscape & Heritage
(C1) RW to COVRA	+	0	0	0	-	0	0	0	0	0	+
(C2) HASS to prod.	+	0	0	0	0	0	0/?	+	0/?	0/?	0
(C3) HW to COVRA / incineration	+	0	0/?	0	0	0	0	+/?	0	0	0
(OS1a) Reprocessing spent fuel	0	0	0	0	0	0	0	+	0	0	0
(CM1a) No reporting obligation	0	0	0	0	0	0	0	0	0	0	0/?
(N1a) RW to current landfills	+	0	0	0	-	0/?	0/?	0	0	0	0
(IM1a) Import / export permitted	0	0	0	0	-	0/?	0	0	0	0	0
Combined effects	+	0	0	0	-	0/?	0/?	+	0	0	+

Note: RW = Radioactive Waste; HASS = High Activity Sealed Sources; Prod. = producers; HW = Hospital waste.

Combined Environmental Effects of the First Half of the Preferred NPRA (2025-2030), by SEA Theme

Radiation Protection – Minor Positive Combined Effects

The preferred NPRA provides a lasting solution for the safe containment, management, and storage of radioactive waste. Over the next five years, the amount of radioactive waste is likely to increase at the same rate as during the period of the NPRA 2016. The current facilities (COVRA and three designated landfills) have sufficient capacity for all Dutch radioactive waste for this period. Additionally, COVRA and the landfills will have to adhere to the current laws and regulations.

The regulations set requirements regarding the information on waste that must be provided in a permit application. When compiling the national waste inventory, the National Institute for Public Health and the Environment (RIVM) found that it is not always straightforward to determine how much waste is actually produced by individual companies, as the quantities mentioned in a permit are maximum allowable quantities. In this SEA of the NPRA, the maximum allowable quantities have been assessed to reflect the most conservative scenario based on the data available.

By safely managing radioactive waste, citizens remain protected from the adverse effects of ionising radiation. The combination of policies in the preferred NPRA will provide a suitable solution for managing all radioactive waste streams in the Netherlands during the first half of the NPRA, and therefore a minor positive effect has been identified.

Biodiversity – Neutral Combined Effects

The preferred NPRA will have neutral effects on biodiversity for the first half of the NPRA. There are no protected natural areas within 1km of the Zeeasterweg or Wieringermeer landfills, minimising the risk of disturbance to species and habitats during operations. The other landfill,

Mineralz on the Maasvlakte, and COVRA are both directly surrounded by ecologically-designated Natura 2000 and Ramsar areas. These existing landfills are expected to continue to take appropriate measures to ensure the safe storage of waste without affecting local biodiversity or habitats.

In this SEA, it is assumed that the transport of radioactive waste will be carried out in accordance with the requirements set out in transport permits. Additionally, it is assumed that the radioactive waste will be transported in suitable packaging to minimise environmental impact and provide adequate shielding. These measures will ensure that unplanned exposures are prevented.

Although there will be an increase in emissions to air due to the increase in traffic movements, this change is not expected to be significant enough to affect biodiversity. The absolute change in emissions is low, and therefore the impact on ecology remains neutral.

Water – Neutral Combined Effects

The preferred NPRA is expected to have no impact on water quality and quantity over the first half of the NPRA. The wastewater discharged at COVRA and the landfills is generally treated in accordance with existing permits. COVRA reports that the wastewater is treated before being discharged from the site, resulting in discharge values for emissions to water that are lower than the permitted values. This means that very few harmful substances enter the water environment. Measures are also taken at the landfills to ensure that the waste is safely stored and that contaminants do not leach into nearby waterbodies.

Soil – Neutral Combined Effects

No change in existing soil quality or impacts on protected geological features are expected over the first five years for the preferred NPRA. This is because COVRA and the landfills (Maasvlakte, Zeeasterweg, and Wieringermeer) are located within existing industrial areas and ports, so no undisturbed soil / greenfield land will be lost. Appropriate measures are in place at these locations to prevent contaminants from leaching into the soil.

Air – Minor Negative Combined Effects

The preferred NPRA has been assessed as having a minor negative effect against the ‘air quality’ theme. For some policies, the transport of radioactive waste is necessary to safely store it at a designated location. Since the air quality around COVRA and the landfills does not meet World Health Organisation (WHO) standards, future transport requirements could further negatively impact air quality, including an increase in particulate matter and nitrogen deposition. There is also a potential for increased greenhouse gas emissions from transportation, depending on the types of vehicles used for transportation. The number of transport movements is relatively low, but they take place in areas with poor air quality. Hence, a negative effect has been identified for various policies and the NPRA as a whole.

Health – Neutral Combined Effects with Some Uncertainty

The preferred NPRA is expected to have no impact on human health. Workers and the public who may come into contact with (the effects of) radioactive waste are protected from its negative effects. Rules and guidelines are applied to determine whether waste can be accepted, and companies handling radioactive waste must comply with existing permits. Additionally, no effects on human health are expected due to deteriorated or improved air, soil, or water quality.

The uncertainty arises because processors and other handlers of radioactive waste set their own acceptance criteria. This could pose a potential risk to the health of employees at these

facilities. However, since all three landfills which accept radioactive waste are licensed by the Authority for Nuclear Safety and Radiation Protection (ANVS), no health problems are expected.

Climate Adaptation – Neutral Combined Effects with Some Uncertainty

The Netherlands has large areas of low-lying land, and in some areas, there is an increased risk of flooding. The three landfill sites that receive radioactive waste are partially within or close to areas with a flood risk. However, the landfills have robust water barriers to protect the sites from sea level rise and flooding. Additionally, COVRA is located several metres above sea level. Therefore, no adaptation measures are expected to be required for the NPRA to mitigate the effects of climate change. However, there is uncertainty about the flood risk, and therefore some corresponding uncertainty is included in the assessment.

No changes in surface coverage or soil permeability are anticipated as a result of the policies. Therefore, no changes in surface water flows and drainage are expected, and the policies themselves will have no effect on flood risk.

Resources – Minor Positive Combined Effects

Several policies within the preferred NPRA individually offer the possibility for reuse, recycling, or volume reduction of radioactive waste. An example of this is the reprocessing of spent fuel. With reprocessing, spent fuel is chemically processed so that uranium, plutonium, and other elements can be separated. The reprocessing of nuclear fuel allows for the recycling of 95% of the usable fuel. This minimises the volume of waste that needs to be stored at COVRA.

Current operations will continue to use approximately the same amount of resources such as energy, water, and materials. The combination of the NPRA policies is assessed as having minor positive combined effects due to the waste reuse and recycling.

Assets & Infrastructure – Neutral Combined Effects

The preferred NPRA is expected to have no notable effects on existing assets and infrastructure, including landfills, COVRA, and transport connections. All waste facilities have existing buildings and structures with sufficient space to accommodate the estimated amounts of radioactive waste over the next five years. This includes the current expansion at COVRA, which is being carried out within the boundary of the existing site. No new assets and infrastructure are needed for the reprocessing of spent fuel. Additionally, the extensive road networks and connections, including the existing train station at COVRA, are not expected to be expanded as a result of the preferred NPRA.

Socioeconomic Aspects – Neutral Combined Effects

The continuation of existing policies provides employment and economic activity at COVRA and the landfills. However, no significant changes in funding or employment are expected during the first half of the NPRA. Moreover, the preferred NPRA is not expected to affect tourism. Overall, this theme is therefore assessed as a neutral effect.

Landscape & Heritage – Minor Positive Combined Effects

No new buildings or infrastructure are expected as a result of these policies, which could affect the landscape. COVRA is currently expanding within the boundaries of the existing site, which is located in an industrial area. A positive effect has been identified due to COVRA's commitment to art preservation, with art also being part of the buildings at COVRA. Art is stored at COVRA for the Zeeuws Museum, and various art objects are exhibited among the barrels of radioactive waste. COVRA organises art exhibitions in the office building, which are free to visit, and the art is changed quarterly. The HABOG building, a large orange structure, is one of the largest artworks in the Netherlands. It symbolises radioactive decay by repainting the building in a

lighter colour every 20 years until the building is white. The blue VOG-2 building, used for storing depleted uranium, is also the largest sundial in Europe, representing the time for radioactive waste to decay to non-radioactive material.

Although these effects are only visible around COVRA, the preferred NPRA will result in minor positive effects on the 'Landscape & Heritage' theme as a significant number of the policies concern COVRA.

Table 0.4: Potential environmental effects of the preferred NPRA for the period 2030-2035.

	Radiation Protection	Biodiversity	Water	Soil	Air	Health	Climate Adaptation	Resources	Assets & Infrastructure	Socio-economic	Landscape & Heritage
(C1) RW to COVRA	+/?	0/?	0/?	+/?	-/?	0	0/?	-/?	0/?	+/?	+/?
(C2) HASS to prod.	+/?	0/?	0/?	0/?	-/?	0/?	0/?	+/?	0/?	+/?	0/?
(C3) HW to COVRA / incineration	+/?	0/?	0/?	0/?	-/?	0/?	0/?	+/?	?	+/?	0/?
(OS1a) Reprocessing spent fuel	+	0	0	0	0	0	0	++	+	0	0
(CM1a) No reporting obligation	-/?	-/?	-/?	-/?	-/?	-/?	-/?	-/?	-/?	-/?	0/?
(N1a) RW to current landfills	-/?	0	0/?	0	-/?	0/?	0/?	-/?	-	-/+	0
(IM1a) Import / export permitted	+/-/?	0/?	0/?	0/?	-/?	0/?	0/?	-/?	-/?	?	0
Combined effects	+/-/?	0/?	0/?	+/?	--/?	0/?	0/?	++/--/?	+/-/?	+/-/?	+/?

Note: RW = Radioactive Waste; HASS = High Activity Sealed Sources; Prod. = producers; HW = Hospital waste.

Combined Environmental Effects of the Second Half of the Preferred NPRA (2030-2035), by SEA Theme

Radiation Protection – Both Minor Positive and Minor Negative Combined Effects with Some Uncertainty

For the preferred NPRA, minor positive effects have been identified due to the availability of safe storage of radioactive waste at COVRA. The available space on site and storage capacity at COVRA are sufficient to meet the expected slight increase in radioactive waste during the second half of the NPRA.

Minor negative effects also arise because the Zeeasterweg and Wieringermeer landfills are expected to reach their maximum capacity within five years. As a result, radioactive waste destined for these landfills (such as NORM waste with specific authorisation for disposal to landfill) will instead have to be deposited at the Maasvlakte landfill during the second half of the NPRA. The Maasvlakte landfill itself is expected to reach its maximum capacity around 2036.

This creates uncertainty about the long-term disposal of this type of radioactive waste, when all three landfills have reached their capacity, which approximately coincides with the end of the period for this NPRA. Under the current moratorium, the capacity at the landfill sites cannot be expanded. Landfill capacity for radioactive waste will still be necessary for a long period of time,

and by the year 2130, it is expected that approximately 56,000m³ of NORM waste will be generated annually, although there is uncertainty in the future estimates.

Biodiversity, Water, Health, and Climate Adaptation – Neutral Combined Effects with Some Uncertainty

For these four SEA themes, neutral effects are expected for the second half of the preferred NPRA. This is mainly because no expansions are expected at COVRA or the landfill sites that could impact biodiversity, water quality, health, or climate adaptation for the period up to 2035.

However, there is uncertainty for the period after 2035. Estimating future amounts of radioactive waste is difficult, as there is no uniform reporting, making it unclear when any expansions need to be realised. The Ministry of Infrastructure and Water Management will continue to monitor the filling rate of the current COVRA site with Key Performance Indicator 1 (KPI 1) as described in the NPRA. The KPI is used to take action towards expanding COVRA or finding alternative locations if required.

For the landfills, it is more challenging to make an accurate estimate of the quantities of waste. Additionally, the landfill capacity is restricted by a moratorium, preventing any expansion. However, landfill capacity will still be necessary for a long period of time. It is currently unclear how landfill capacity will be realised for the period after this NPRA and what impact this may have on these themes during this NPRA.

Soil – Minor Positive Combined Effects with Some Uncertainty

COVRA is expected to have sufficient capacity within the existing site for the storage of all radioactive waste from across the Netherlands until 2080 (excluding radioactive waste that goes to the landfill). It is assumed that any future expansion before 2080 at COVRA will take place within the site boundaries. This would prevent the loss of currently undisturbed soil at a new location. The environmental effects of any expansions at COVRA will need to be assessed in separate project EIAs when relevant.

There is currently a lack of a reporting obligations for COVRA or operators of radioactive waste landfills. There is an ongoing risk that limited information on future waste quantities could lead to an increased risk of soil contamination when a short-term solution for waste storage needs to be found. These are likely to be localised effects, and there remains sufficient capacity for the safe management of waste at COVRA and Maasvlakte for the period of this NPRA. Therefore, this is represented with uncertainty.

Air – Major Negative Combined Effects with Some Uncertainty

During the second half of the NPRA and beyond, there is expected to be an increase in the volumes of radioactive waste. The transport of radioactive waste to the sites will likely lead to increased emissions of greenhouse gases, particulate matter, and nitrogen. This will also result in an increase in traffic movements in areas where air quality does not meet WHO standards. COVRA is expected to continue to operate as the central collection service for radioactive waste in the Netherlands. This will lead to an increase in traffic to transport waste from the 12 provinces and various facilities to COVRA. The Maasvlakte landfill will likely be the only landfill that can still receive registered and specifically released waste after 2030, with a corresponding increase in transport to Maasvlakte (and reduction in transport to the Zeeasterweg and Wieringermeer landfills). An increase in emissions to air is therefore expected in areas where values already exceed WHO recommended limits.

The continuation of policies within the preferred NPRA, along with the increase in radioactive waste over the second half of the NPRA, will likely further deteriorate air quality in the Netherlands around the transport routes. For the period after this NPRA, there is currently uncertainty about where registered and specifically released waste can be disposed of.

Resources – Major Positive and Major Negative Combined Effects with Some Uncertainty

Some of the policies within the preferred NPRA promote the waste hierarchy, while others do not. The waste hierarchy is a ranking for waste management that prioritises environmentally-friendly processing methods, ranked from most to least desirable: prevention, reuse, recycling, energy recovery, incineration, landfill. The policies that promote the waste hierarchy offer the possibility for reuse, recycling, or volume reduction of radioactive waste. This minimises the amount of waste stored at COVRA. This includes, for example, the incineration of released medical waste at ZAVIN and the return of High Activity Sealed Sources (HASS) to manufacturers for reuse. The reuse provides an alternative to temporary storage and final disposal.

Several policies do not offer the possibility to minimise radioactive waste at the source, making landfill necessary. The implementation of the preferred NPRA results in increased use of resources and energy to dispose of radioactive waste that goes to the landfill.

After the period of this NPRA, increased volumes of radioactive waste are expected in the Netherlands. This includes a predicted increase in high-level radioactive waste. Due to these increased volumes, which require processing and storage, the demand for resources at COVRA may increase. Therefore, the programme as a whole is expected to potentially place an increased pressure on resources.

For the preferred NPRA, both a major positive and a major negative combined effect have therefore been identified. The effects have not been offset against each other to ensure that the potential effects are still clearly reported to allow for mitigation and improvements.

Assets & Infrastructure – Both Minor Positive and Minor Negative Effects with Some Uncertainty

For the preferred NPRA, minor positive effects are expected due to the reprocessing of spent fuel. The reprocessing of spent fuel at existing facilities in France reduces the impact on existing infrastructure in the Netherlands, such as COVRA.

As noted above, during the second half of the NPRA, radioactive waste destined for landfill is expected to be sent to Maasvlakte. This results in an increased demand for capacity at Maasvlakte, causing increased pressure on the local road network. There is also a possibility that the resulting increase in waste volumes at Maasvlakte could result in the site reaching capacity sooner than currently expected.

Socioeconomic Aspects – Both Minor Positive and Minor Negative Effects with Some Uncertainty

COVRA has sufficient capacity within the existing site for the storage of radioactive waste from across the Netherlands until 2080. If expansions (possibly after 2035) are realised at the site, this could provide benefits through increased employment and training opportunities within the sector, as waste volumes increase in the future.

Additionally, the policies concerning the return of HASS to manufacturers and central storage of hospital waste at COVRA also provide socioeconomic benefits, as the volumes of HASS and hospital waste are expected to increase. The policies promote long-term economic development and financial incentives around the management of radioactive waste, and there is a potential associated increase in employment. As existing policy is being continued, the nuclear industry does not need to invest to meet new requirements and adapt existing processes that an alternative programme might impose. This assessment takes into account that these policies are likely to remain in place beyond 2035, giving rise to a larger effect than for the first five years of the NPRA.

The potential capacity issues at existing landfills under the current moratorium could result in loss of employment and funding associated with radioactive waste management at those sites. It is not yet clear how economic growth in some areas will affect decline elsewhere, causing some uncertainty for the entire programme.

Landscape & Heritage – Minor Positive Effects with Some Uncertainty

For the preferred NPRA, minor positive effects with some uncertainty have been identified, for the same rationale as the first half of the NPRA.

Effects of the Preferred NPRA with National Programmes and Plans

During the implementation of the preferred NPRA, potential environmental effects and opportunities may arise when it is implemented simultaneously with other national plans and programmes. In this SEA, the Circular Materials Plan (CMP); the Landfill Work Programme 2024-2029; the National Energy System Plan (NPE); the Climate Agreement; the National Water Programme 2022-2027; and the Government-wide Circular Economy Programme: 'Netherlands Circular in 2050' have been considered. The preferred NPRA may be affected by the CMP, the Landfill Work Programme, the NPE, and the Government-wide Circular Economy Programme.

Although radioactive waste is not included in the CMP, there may be interactions with the NPRA. Both programmes contribute to the common goal of sustainably managing all types of waste. Both positive and negative cumulative effects have been identified for the implementation of the NPRA in relation to the CMP. The positive effects arise from potential opportunities to manage radioactive waste together with waste streams identified within the CMP, resulting in positive cumulative effects for the themes 'socioeconomic aspects' and 'resources'. However, there may be increased pressure on non-radioactive waste management facilities and processes due to the hazardous chemical or biological parts of some types of radioactive waste. This has been identified a negative cumulative effect for the theme 'assets and infrastructure'.

The Landfill Work Programme 2024-2029 aims to create a sustainable and future-proof landfill system in the Netherlands. This programme is part of the Dutch Government's efforts to sustainably manage waste and transition to a circular economy, and it applies a moratorium on the expansion of landfill capacity. The programme emphasises the importance of minimising landfill to work towards a circular economy. The programme states that most landfills are located outside urban centres, such as the Randstad, which can lead to potential issues with regional availability. This is closely related to the NPRA, with cumulative effects concerning landfill capacity and the disposal of registered and specifically released waste in particular. Negative cumulative effects therefore may arise for the NPRA and the Landfill Work Programme for the SEA themes 'resources' and 'assets and infrastructure'.

The NPE emphasises the need for additional and new energy infrastructure in the Netherlands to ensure a robust and reliable energy system. Adverse cumulative effects have the potential to occur for the preferred NPRA if the plans from the NPE are implemented. The NPE may lead to an increase in nuclear energy, for example, through the proposed development of SMRs and other nuclear power plants by 2050. These developments would result in an increase in the production of radioactive waste in the Netherlands and thus potentially increase pressure on resources, buildings and infrastructure, including possible pressure on COVRA while a final disposal facility is being developed. Additionally, geothermal energy is mentioned as an important source of sustainable heat. Geothermal energy can contribute to the energy transition by providing reliable and renewable energy. With an increase in geothermal energy, the amount of NORM waste requiring disposal at landfill may also increase. As a result, negative cumulative effects have been identified for the SEA themes 'resources' and 'assets and infrastructure'.

Although the exact timelines and scope of the infrastructure that may result from the NPE are currently unknown, it is assumed that all effects of new infrastructure projects will be assessed individually as part of their own project EIAs. Potential cumulative effects include impacts on local communities due to increased transport, resulting in increased emissions to air and potential effects on local biodiversity and human health. However, these developments may also increase employment and economic funding, resulting in positive socioeconomic effects.

The Government-wide Circular Economy Programme aims for a fully circular economy in the Netherlands by 2050. It is expected that new policies will be implemented to achieve this. The NPRA is also expected to comply with these policies. The preferred NPRA may result in an increase in resource consumption in the long term, which may conflict with the current ambitions and intentions of the Government-wide Circular Economy Programme. In the preferred NPRA, reporting of radioactive waste by recipients is not required. This makes it difficult to estimate quantities, as there is no uniform reporting. Therefore, it offers limited opportunities to promote efficient disposal measures.

Transboundary Effects of the Preferred NPRA

The preferred NPRA continues the reprocessing of spent fuel in France. Therefore, there will be transport to/from the Orano site (La Hague, France) and reprocessing of spent fuel in France (policy OS1a). However, transboundary effects on France are not expected due to the low frequency of transport and reprocessing of material from the Netherlands, which occurs once every 1 to 2 years with transport by rail.

No direct transboundary environmental effects are expected as a result of the preferred NPRA on the bordering countries Belgium, Germany, and the United Kingdom. Due to COVRA's proximity to the Belgian border, there are potential indirect transboundary effects on air quality due to increased traffic movements leading to increased air emissions. However, it is expected that the effects are likely to remain localised within the Netherlands.

There are possible future opportunities with France, Belgium, and the UK to share lessons learned with regard to final geological disposal, and to ensure that no cumulative effects occur with each country’s geological disposal plans. This could have positive transboundary effects on the SEA theme 'socio-economic aspects' due to improved public trust, governance and decision-making.

Accidents and Disasters

There is always a chance that potential accidents and disasters will affect the Netherlands. However, it is expected that the implementation of stringent existing control measures by the National Cyber Security Centre (NCSC) and the National Coordinator for Security and Counterterrorism (NCTV) will mitigate and manage these risks. All possible precautionary measures have been taken, and the policies in the preferred NPRA will not influence this. The existing control measures for avoiding and managing disaster situations fall outside the scope of the NPRA and are therefore not further assessed in this SEA.

Comparison of the Preferred NPRA with the Alternatives

Based on the combined and cumulative effects for each programme, relatively small differences in environmental effects have been identified between the preferred NPRA and Alternatives 1 and 2. The most significant differences between these programmes are expected for the second half of the NPRA and are described below.

Landfill Capacity for Radioactive Waste

The preferred NPRA assumes the continued use of the Zeeasterweg, Wieringermeer, and Maasvlakte landfill sites until the maximum capacity is reached at all three landfills (likely in 2036). The preferred NPRA may lead to negative effects as the landfill capacity at the three landfills is expected to be reached relatively soon if the current situation continues.

Alternative 1 (based on the policies with the most favourable environmental effects) offers a solution to this capacity problem by assuming the use of a larger number of existing landfills across the country that are technically suitable to receive radioactive waste but do not yet do so (policy N1c). More favourable environmental effects have been identified for this policy as more local disposal would likely take place, leading to reduced transport.

Alternative 2 (based on the NPRA principle of 'no unreasonable burdens on future generations') assumes the disposal of radioactive waste at a single central location in the country (Maasvlakte) (policy N1b). However, this requires a change to the existing moratorium on landfill expansion to allow for capacity expansion at Maasvlakte. This alternative is expected to have greater public acceptance as radioactive waste is disposed of at only one location, in a highly industrialised area. However, the solution may create a monopoly in favour of a private company.

This policy has less favourable environmental effects than N1a (preferred NPRA) or N1c (alternative 1) for two reasons. Firstly, the Maasvlakte landfill must be expanded to accommodate larger waste volumes. Based on current estimates, the Maasvlakte landfill is expected to reach capacity by 2036. The maximum capacity may be reached earlier once the Wieringermeer and Zeeasterweg landfills reach their capacity, and radioactive waste is likely directed to Maasvlakte instead.

Secondly, the centralised use of the Maasvlakte landfill (including expansion) is more vulnerable to sea level rise. A possible expansion would require a larger land intake, and future sea level rise must be considered. When a single landfill is used, it is also less resilient to the effects of climate change and possible flood risk than when multiple landfills are used.

Capacity Management of COVRA and the Landfills

The Maasvlakte landfill and COVRA will have sufficient capacity for registered radioactive waste or radioactive waste with an authorisation for specific release for the duration of the NPRA. However, there is significant uncertainty about the available landfill capacity after 2035, as it is expected that capacity will be reached around 2036. The preferred NPRA does not seek to manage this bottleneck. A separate programme, the Landfill Work Programme 2024-2029, exists for this purpose.

In both Alternatives 1 and 2, an alternative policy, prescribing a reporting obligation for COVRA or operators of radioactive waste landfills, is included. This policy has clear environmental benefits for after the NPRA, as it is expected to provide a better understanding of future quantities of radioactive waste and capacity limits of the facilities. This allows for easier anticipation of future waste volumes and ensuring adequate management facilities are in place.

Based on findings from this SEA, the Ministry has decided to include a reporting obligation within the NPRA on storage capacity for COVRA and monitoring of received quantities of radioactive waste for the landfills.

Mitigation Measures & Monitoring Proposals

Identification of appropriate mitigation measures is an essential part of the SEA to reduce any potential adverse impacts. During the SEA process, some potential environmental risks for the preferred NPRA have been identified. In section 9.1 of the main SEA Environmental Report,

recommendations for mitigation measures have been made. These must be implemented to prevent or reduce the potential negative effects on the environment of the NPRA. For each SEA theme, three types of mitigation measures have been identified: mandatory mitigation measures (e.g. specified in regulations); mitigation measures currently in place (e.g. already occurring for current activities and assumed to continue through the NPRA); and new recommendations arising from the SEA.

The mitigation hierarchy must be applied to reduce the negative environmental effects of the preferred NPRA. The mitigation hierarchy is a step-by-step approach used to limit environmental damage when planning projects or activities. The four phases, from highest to lowest preference, of the mitigation hierarchy are: avoid, minimise, restore, and compensate.

For the second half of the NPRA, major negative effects have been identified for the preferred NPRA for the SEA themes 'air' and 'resources'. The recommendations to mitigate the effects for these two themes are outlined below.

Recommendations for 'Resources' theme:

- Aim to use energy-efficient, emission-free machinery and equipment in the ongoing operations of waste disposal/storage sites and in the sorting, transport, and reprocessing of waste.
- Encourage the minimisation of waste production, in line with the waste hierarchy.
- Prioritise waste mitigation, focusing on diverting waste to landfills.
- Review existing operational practices to explore the use of renewable energy, rainwater harvesting, and greywater recycling.
- Support the continuation of innovation and research into the reuse and recycling of radioactive waste, in line with the mitigation hierarchy.
- Explore sustainable design methods such as using materials with low embedded carbon and reusing excavated material.
- Review design requirements to minimise the use of concrete and non-renewable materials.
- Develop minimisation strategies to reduce registered radioactive waste or radioactive waste with an authorisation for specific release and increase opportunities for reuse and recycling of these waste streams.
- Assess opportunities for a circular economy concerning the import or export of NORM waste. For example, identify reuse or recycling of imported/exported NORM waste instead of landfill disposal.

Recommendations for 'Air' theme:

- Reduce transport emissions where possible. This can be achieved by avoiding idling vehicles, avoiding peak hours for waste transport to the site, and using electric vehicles where possible.
- Monitor air quality around waste disposal/storage sites.
- Implement a traffic management plan for construction (where applicable) to reduce the impact of construction traffic on air quality.
- Use renewable energy sources where possible.
- Conduct transport models to determine the impact of policies on air quality (where applicable).
- Consider alternative modes of transport besides road transport to reduce emissions to air.

Next steps

The environmental effects of the preferred NPRA and the alternatives will be considered when drafting the final NPRA by the Ministry of Infrastructure and Water Management. For the second half of the NPRA, potential major negative effects have been identified for the preferred NPRA for the SEA themes of 'air' and 'resources'. The mitigation measures, specifically for these two themes, must be considered when implementing the preferred NPRA to avoid significant environmental effects.

The SEA will be available for public consultation along with the draft NPRA 2025-2035 for a period of six weeks. During this consultation period, anyone can submit their views. A digital information meeting will also be held during the consultation period. During this time, the SEA Committee will issue its advice on the SEA and the draft NPRA. The advice of the SEA Committee and the various views received will be compiled and addressed in a Consultation Response Note.

All documents can be found at www.platformparticipatie.nl/npra.

List of abbreviations & acronyms

Abbreviation	Definition
ANVS	Autoriteit Nucleaire Veiligheid en Stralingsbescherming (Authority for Nuclear Safety and Radiation Protection)
CMP	Circulaire materialenplan (Circular Materials Plan)
COVRA	Centrale Organisatie Voor Radioactief Afval (Central Organisation for Radioactive Waste)
EIA	Environmental Impact Assessment
EURATOM	European Atomic Energy Community
HABOG	Hoog radioactief Afval Behandeling Opslag Gebouw (High-Level Radioactive Waste Treatment and Storage Building at COVRA)
HASS	High Activity Sealed Sources
HFR	High Flux Reactor
HLW	High-Level Waste
HW	Hospital Waste
ILW	Intermediate-Level Waste
KPI	Key Performance Indicator
LLW	Low-Level Waste
NCSC	Nationaal Cyber Security Centrum (National Cyber Security Centre)
NCTV	Nationaal Coördinator Terrorismebestrijding en Veiligheid (National Coordinator for Security and Counterterrorism)
NORM	Naturally Occurring Radioactive Materials
NPE	Nationaal Programma Energiesysteem (National Energy System Plan)
NPRA	Nationaal Programma Radioactief Afval en verbruikte splijtstoffen (National Programme for Radioactive Waste and spent fuel)
PALLAS	Name of the new medical isotopes reactor in Petten
RIVM	Rijksinstituut voor Volksgezondheid en Milieu (National Institute for Public Health and the Environment)
RW	Radioactive Waste
SEA	Strategic Environmental Assessment
UK	United Kingdom
VOG	Verarmd uranium Opslag Gebouwen (Depleted Uranium Storage Building at COVRA)
WHO	World Health Organization
ZAVIN	Ziekenhuis Afval Verwerkingsinstallatie Nederland (Waste Incineration Facility in the Netherlands)