Tentative Translation

Results of Initiatives to Date towards Final Disposal Outside Fukushima Prefecture and Approaches beyond FY2025

Summary of the Achievement of the “Technology Development Strategy for Volume Reduction & Recycling of Removed Soil and Waste under Interim Storage”

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1. Introduction

In order to promptly reduce the impact of environmental contamination caused by radioactive materials resulting from the accident at the Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Station that occurred in March 2011 on human health and the living environment , various initiatives such as off-site decontamination, treatment of contaminated waste, and development of the Interim Storage Facility (hereinafter "ISF") have been promoted based on the "Act on Special Measures Concerning the Handling of Environmental Contamination by Radioactive Materials Discharged by the Nuclear Power Station Accident Associated with the Tohoku District-Off the Pacific Earthquake That Occurred on March 11, 2011 (Act No. 110 of 2011)" (hereinafter "Act on Special Measures") and other related laws.

In Fukushima Prefecture, by the end of FY2021, the transport of removed soil and waste to the ISF, excluding those arising from the Restricted Area, has completed. Currently, Specified Living Areas for Returnees have been designated as areas where residents who wish to return can return and live, decontamination of these areas began in December 2023.

With regard to soil and waste arising from decontamination activities in Fukushima Prefecture, the "Law for the Japan Environmental Storage and Safety Corporation (Act No. 44 of 2003)" clearly stipulates that it is the responsibility of the national government to "take the necessary measures to complete the final disposal outside Fukushima Prefecture within 30 years from the start of interim storage."

The scope of the final disposal outside Fukushima Prefecture includes removed soil and waste transported and stored at the ISF, which is removed soil and waste arising from decontamination activities in Fukushima Prefecture and waste contaminated by radioactive caesium from the accident (limited to materials with radioactivity concentration exceeding 100,000Bq/kg). As of the end of December 2024, approximately 14 million cubic meters of removed soil and waste has been transported to the ISF.

In order to achieve final disposal outside Fukushima Prefecture, the key is to reduce the volume of soil to be disposed of by volume reduction and managed recycling, and consideration has been given to managed recycling of removed soil with a radioactivity concentration of 8,000 Bq/kg or less, which is assessed as resulting in an additional exposure dose of 1 mSv/year or less. Furthermore, taking the half-life of radioactive caesium into account, it is estimated that as

of March 2025, approximately three-quarters of the removed soil transported to the ISF is 8,000 Bq/kg or less, and approximately one-quarter is more than 8,000 Bq/kg.

In order to consider technical issues related to volume reduction and managed recycling of the removed soil and waste, as well as items related to the promotion of managed recycling, the "Study Group on Technology Development Strategy for Volume Reduction and Recycling of Removed Soil and Waste under Interim Storage" (hereafter "Strategy Study Group") was established in July 2015, consisting of experts. Based on the discussions of the Strategy Study Group, the "Technology Development Strategy for Volume Reduction and Recycling of Removed Soil and Waste under Interim Storage (hereinafter 'Technology Development Strategy')" was formulated in April 2016 as a policy for period of approximately 10 years. The Technology Development Strategy mainly outlines policies on "development of volume reduction and managed recycling technologies", "promotion of managed recycling", "consideration of the direction of final disposal", and "fostering nationwide understanding." Based on the status of initiatives to date, the strategy was revised in March 2019.

Based on the Technology Development Strategy, we have been promoting managed recycling by developing volume reduction technologies for removed soil and waste, accumulating data on safety through projects such as the demonstration project for recycling removed soil in Fukushima Prefecture, and formulating standards and guidelines for managed recycling. In addition, based on studies on final disposal standards and final disposal scenarios that combine volume reduction technologies, studies have been implemented to present multiple options for the structure and required area of final disposal sites. At the same time, various initiatives have been implemented foster nationwide understanding.

In FY 2023, at the request of the Ministry of the Environment, Japan (hereinafter "MOE Japan"), the International Atomic Energy Agency (hereinafter "IAEA") held three "IAEA-MOE Japan Experts Meeting on Volume Reduction and Recycling of Removed Soil Arising from Decontamination Activities" to provide international assessment and advice from a technical and social perspective on the managed recycling and final disposal of removed soil and waste in the future. In September 2024, the final report summarizing the results of the three meetings were handed over to the Minister of the Environment and was published by the IAEA. The final report

states, “Approach and activities implemented by MOE Japan to date for the managed recycling and the final disposal are consistent with the IAEA Safety Standards” and “Looking ahead, with continuous efforts to meet fully the advice provided by the team of experts, MOE Japan’s evolving approach will be consistent with the IAEA Safety Standards. This can be confirmed by future follow-up assessments”

In addition, in March 2024, the Cabinet decided on a policy to “promote efforts to establish a unified system through enhanced cooperation among relevant ministries and agencies for the creation of recycling destinations” in the review of the “Basic Guidelines for Reconstruction in Response to the Great East Japan Earthquake from the “Second Reconstruction and Revitalization Period.”” In light of this, the “Council for the Promotion of Managed Recycling for the Realization of Final Disposal of Removed Soil and Waste Outside Fukushima Prefecture” (hereinafter “the Promotion Council”), consisting of all ministers of state except the Prime Minister, was established to promote measures for reducing the volume for final disposal through managed recycling of removed soil arising from decontamination activities in Fukushima Prefecture, and measures to counter the effects of harmful rumors. The first meeting was held in December 2024.

“Results of Initiatives to Date towards Final Disposal Outside Fukushima Prefecture and Approaches beyond FY2025” (hereinafter “Approaches beyond FY2025”) outlines the approach to be taken beyond FY2025 based on the results of initiatives to date under the Technology Development Strategy, focusing on ‘Promotion of managed recycling’, ‘Consideration of the direction of final disposal’ and ‘Fostering nationwide understanding’ with the aim of achieving final disposal of removed soil and waste arising from decontamination activities outside Fukushima Prefecture.

2. Basic Concept

In order to achieve final disposal outside Fukushima Prefecture, it is important to promote managed recycling to reduce the volume for final disposal. It is necessary to promote project creation in cooperation with the relevant ministries and agencies with a view to full-scale implementation of managed recycling. In addition, although volume reduction technologies has been developed, when applying such technologies, it is necessary to carefully examine the final disposal scenarios, taking into consideration the overall efficiency and social acceptability of the system, and consider the direction of final disposal. Furthermore, it is important to promote a nationwide understanding and trust

regarding the necessity and safety of managed recycling and final disposal, as well as to improve social acceptance.

Based on the above, with the aim of realizing final disposal outside Fukushima Prefecture,, initiatives will be promoted beyond FY2025 based on the three main pillars of "Promotion of managed recycling", "Consideration of the direction of final disposal", and "Fostering nationwide understanding". In the Approaches beyond FY2025, the results of initiatives to date will be organized in line with these three pillars, and the results of the "development of volume reduction and managed recycling technologies" in the Technology Development Strategy, will be described in the chapter on "Consideration of the direction of final disposal".

3. Promotion of Managed Recycling

(1) Initiatives to date

1) Implementation of managed recycling demonstration project

Based on the discussions of the Strategy Study Group, MOE Japan compiled the "Basic Approach to the Safe Use of Removed Soil Processed into Recycled Materials" (hereinafter "Basic Approach") in June 2016.

Based on Basic Approach, the safety and other aspects were confirmed in Fukushima Prefecture through the test embankment construction demonstration project at the Temporary Storage Site (hereinafter "TSS") in Minamisoma City, the agricultural land demonstration project (environmental restoration project) in Nagadoro District of Iitate Village, and the road embankment demonstration project in the premises of the ISF.

The details are as follows.

・The test embankment construction demonstration project at the TSS in Minamisoma City

A demonstration project was implemented at the Eastern TSS in Odaka Ward, Minamisoma City, in order to confirm the methods for processing removed soil into recycled materials and the safety of managed recycling. After implementing demonstration tests to process removed soil into recycled materials from April 2017, a test embankment was constructed using removed soil processed into recycled materials from May. In this test embankment construction demonstration project, air dose rates were measured around the embankment, the radioactivity concentration of the permeated water from the embankment was measured, and air dose rates and radioactivity concentration in the atmosphere were measured at the site boundary.. Regarding the air dose rates around the embankment, no

significant changes were detected from the time the of completion of the test embankment until it was dismantled, and the air dose rates were almost the same as those at the site boundary. The radioactivity concentration of the permeated water from the embankment was below the detection limit. No significant change in the radioactivity concentration in the atmosphere were detected before the transport of the removed soil, after the completion of the embankment, and after the start of the dismantling of the test embankment in August 2021.

・The Agricultural Land Demonstration Project (Environmental Restoration Project) in Nagadoro District of Iitate Village

In November 2018, a demonstration project was launched in Nagadoro District of Iitate Village to create agricultural land by using removed soil arising from decontamination activities within the village to create recycled materials and used as embankment through process such as removing foreign materials, and then covered them with topsoil. This demonstration project has been positioned in the Iitate Village Specified Reconstruction and Revitalization Base Areas Reconstruction and Revitalization Plan. The use of the removed soil arising from decontamination activities within the village, also contributed to reducing the volume of removed soil transported to the ISF. In this project, the removed soil from the TSS within the village was first transported to a stockyard in Nagadoro District, where a facility for processing the soil into recycled materials was constructed. As part of the process of processing the soil into recycled materials, removing foreign materials, and measuring radioactivity concentration were implemented.

In 2019, two embankments were constructed for cultivation experiments, and experiments were carried out on the cultivation of flowers and resource crops to obtain scientific knowledge on the migration of radioactive caesium. From 2020, comparisons were made on the safety and growth of crops, including food crops, with and without covering soil. These embankments were dismantled in March 2022. After confirming the safety through cultivation experiments, large-scale agricultural land creation using the removed soil as materials to raise the height of the agricultural land began in April 2021. After the agricultural land was created, paddy field tests and tests applying agricultural methods that convert paddy fields into cropland and cultivate crops in rotation were conducted in two sections. The results of the tests confirmed that the radioactivity concentration of rice (brown rice, rice husks, rice straw) were sufficiently below the standard for general food (100 Bq/kg) and the standard for agricultural materials (400 Bq/kg). In addition, the

results of the paddy field tests showed that the permeability and drainage were largely sufficient, and the crops grew well, so it was confirmed that the land could be used as a paddy field. Furthermore, monitoring results have shown that there has been no change in the air dose rate before and after construction, and that the concentration of radioactive caesium in the infiltrated water is below the detection limit or below the drainage standard.

In order to hear opinions from technical and practical perspectives on the implementation of this project, the “Iitate Village Nagadoro District Environmental Revitalization Project Management Council” was established in 2018, with local residents, experts, and others as constituent members (secretariat: Ministry of the Environment and Iitate Village). 17 meetings have been held by March 2025. The council's opinions are reflected in the project's policies.

・The Road Embankment Demonstration Project in the premise of the ISF
A demonstration project to use removed soil processed into recycled materials for road embankment in the premise of the ISF began in October 2022. The road embankment is classified as Type 3, Grade 2 (traffic volume of 4,000 to 20,000 vehicles per day) with sidewalk, and was completed in October 2023. Safety and structural stability of the road embankment were confirmed through monitoring of radiation and settlement, and road usability was confirmed through driving tests. In terms of safety, it was confirmed that the air dose rate remained at the same level before and after the construction of the embankment. Also, in terms of structural stability, it was confirmed that there was no settlement that would compromise stability based on the results of settlement monitoring and driving tests in which large vehicles were driven on the embankment to apply load. As for usability as a road, the aforementioned driving test results confirmed that there were no changes in road surface flatness or rutting that would affect usability.

Based on the results of the demonstration projects in Fukushima Prefecture, demonstration projects outside Fukushima Prefecture were planned with the aim of building further understanding by providing opportunities for many people to observe for themselves the safety of managed recycling. In December 2022, explanatory meetings were held in some areas.

2) Consideration of standards and guidelines for managed recycling

In order to smoothly promote the use of removed processed into recycled materials, the Draft Guidelines for the Managed Recycling of Removed Soil Arising from Decontamination Activities in Fukushima Prefecture (hereinafter "Draft Guidelines for Managed Recycling") was presented to the Study Group in December 2019. Since the presentation of the Draft Guidelines for Managed Recycling, efforts have continued to accumulate knowledge through demonstration projects. In August 2022, Working Group for Considering Initiatives for the Managed Recycling of Removed Soil and Waste in the ISF" (hereinafter "Managed Recycling WG") was established under the Study Group to launch a full-scale discussion on the formulation of standards and guidelines for the managed recycling of removed soil.

Based on the results of demonstration projects, the following seven items are identified as key points of the draft standards for managed recycling of removed soil.

(1) Radioactive caesium concentration in the removed soil processed into recycled materials (set at 8,000 Bq/kg or less to ensure that the additional exposure dose does not exceed 1 mSv/ year or less)
(2) Prevention of dispersal and runoff
(3) Measurement of air dose rates (during construction, and during operation and maintenance)
(4) Preservation of the living environment (noise, vibration, etc.)
(5) Notice indicating that the site is using removed soil processed into recycled materials
(6) Recording and preservation of information on the location and amount of removed soil processed into recycled materials is used, as well as its radioactivity concentration, etc.
(7) Consultation with the operator of the structure and facility manager on the division of roles in construction and management

The draft standards were submitted to the Radiation Council for consultation, and after receiving a report in February 2025 stating that they were deemed appropriate, the amended Ministerial Ordinance and related notifications, including the standards for the managed recycling of removed soil, were promulgated in March 2025.

After conducting a series of reviews based on the "Draft Guide for Managed Recycling" presented at the 8th Strategic Study Group meeting held in March 2018, the guidelines were formulated in March 2025, adding explanations and details on the operation of the standards for managed recycling while maintaining the original objectives, and considering the application of the guidelines to removed soil outside Fukushima Prefecture.

The final report of the IAEA Expert Meeting assessed that the overall safety assessment of managed recycling is sufficiently conservative and that the dose criteria can be achieved sufficiently by using soil with a radioactivity level of 8,000 Bq/kg or less.

3) Consideration of approaches to communication with local communities and coexistence with local communities

In order to improve social acceptance in local communities for the managed recycling and final disposal of removed soil and waste, a "Working Group on Measures to Ensure Social Acceptance in Local Communities for the Managed Recycling and Final Disposal of Removed Soil and Waste in the Interim Storage Facility" (hereinafter "SALC WG") was established in January 2024 under the Strategy Study Group to discuss communication with local communities and the ways to achieve coexistence with local communities. Regarding managed recycling, issues identified through discussions and views on them were compiled as knowledge that supplements the guidelines.

(2) Status of achievement of the Technology Development Strategy goals and future challenges

In order to gradually improve the social acceptance of managed recycling, based on the "Basic Concept for Safe Use of Removed Soil Processed into Recycled Materials (hereinafter "Basic Concept"), demonstration projects were implemented in Fukushima Prefecture to compile data on managed recycling, and methods for establishing a communication framework with related organizations, including those in the local communities, were considered and implemented. In addition, initiatives to foster understanding were implemented, such as holding site visits of facilities that are models for managed recycling.

The Managed Recycling WG had been held since August 2022, and based on the results of demonstration projects in Fukushima Prefecture, full-scale consideration of standards and guidelines for managed recycling was launched with the aim of full-scale implementation of managed recycling in practical applications. These standards and guidelines were formulated in March 2025.

Furthermore, the Promotion Council was established to promote measures to reduce the volume of final disposal through the managed recycling of removed soil and waste, as well as countermeasures against reputational damage, with the government working in unison.

Given the progress made in accumulating scientific knowledge, developing systems, and establishing promotion frameworks, going forward, it is necessary

to promote initiatives to create projects for managed recycling and gradually improve the social acceptance of managed recycling. In addition, the standards for managed recycling newly established in the amended Ministerial Ordinance stipulate various measures to be taken when implementing managed recycling, but since there are no stipulations regarding the end period of these measures, it is necessary to organize the concept of the end of special attention related to managed recycling.

It is also important to expand and review the content of the guidelines as necessary, such as when new knowledge is obtained through these efforts.

(3) Approaches beyond FY2025

Based on discussions at the Promotion Council, the creation of projects for managed recycling in practical applications in cooperation with relevant ministries and agencies will be promoted. In addition, consideration and coordination of appropriate methods of communication with relevant organizations, including local communities, will be conducted in accordance with the intended use of managed recycling.

In addition, in order to improve social acceptance in areas where managed recycling is being considered, accumulation of knowledge on communication with local communities and framework of achieving coexistence with local communities will be promoted based on the progress of future managed recycling initiatives and full-scale discussions on final disposal. Also, in order to gradually improve social acceptance of managed recycling, the agricultural land demonstration project (environmental restoration project) in Nagadoro District of Iitate Village and the road embankment demonstration project in the ISF will be continued, and monitoring of air dose rates and other parameters will be implemented. These projects will also be used as opportunities to foster understanding for the creation of managed recycling projects. With regard to the end of special attention on managed recycling, considerations will be made, based on the results of monitoring of managed recycling, under what circumstances or at what point in time the measures specified in each item of the newly established Article 58-4 of the amended Ministerial Ordinance, such as measures to prevent dispersal and runoff, indication of locations where managed recycling is conducted, and measurement of air dose rates, can be lifted.

Furthermore, if new knowledge is gained through these initiatives, the content of the guidelines will be expanded or revised as necessary.

4. Consideration of the Direction of Final Disposal

(1) Initiatives to date

Toward final disposal outside Fukushima Prefecture, a technology demonstration project was implemented first to develop technologies for volume reduction and managed recycling. In September 2022, the "Working Group on Study of Volume Reduction Technologies of the Removed Soil and Waste in the ISF" (hereinafter "Technology WG") was established under the Strategy Study Group. The members of the working group evaluated volume reduction technologies based on the results of the technology demonstration projects and considered combinations of volume reduction technologies to present multiple options for final disposal outside Fukushima Prefecture. During the study, the volume and radioactivity concentration of removed soil and waste subject to final disposal were estimated, and the evaluation of volume reduction technologies, their application and combination, and the standards for final disposal were studied in parallel. The safety of the final disposal scenario was also confirmed through radiation safety assessment.

1) Implementation of a technology demonstration project for technology development

In order to clarify the goals and priorities for developing technologies required for volume reduction and managed recycling of removed soil and waste, and to complete the development of the basic technologies for implementation within approximately 10 years (by FY2024), technology demonstration projects were implemented to develop and compile volume reduction and managed recycling technologies.

Since 2011, small-scale technology demonstration projects have been implemented based on proposals on technologies for volume reduction and managed recycling of removed soil and waste submitted by private companies, universities, research institutions and other organizations through public offerings. To date, 22 small-scale projects have been implemented for classification technologies, six for thermal treatment technologies, seven for chemical treatment technologies, four for fly ash cleaning technologies, and 16 for stabilization technologies. With the aim to develop technologies for the efficient volume reduction, managed recycling and final disposal of removed soil and waste, a technology demonstration field was constructed in Okuma Town, and began operation in FY2019.

From FY2016 to FY2017, a facility for technology demonstration project under national jurisdiction was constructed in Iitate Village to conduct thermal

treatment of removed soil and waste., The project collected radioactive caesium from the removed soil and waste as fly ash through volatilization and separation, and obtained products whose radioactivity concentration was greatly reduced.

From FY2018 to FY2019, a facility for technology demonstration project under national jurisdiction for classification technology was constructed in Okuma Town, and tests were conducted to classify and treat multiple types of removed soil with different soil types and radioactive concentrations, and to obtain data on classification performance and decontamination rates.

From FY 2022, a facility for technology demonstration project under national jurisdiction for fly ash cleaning, adsorption and stabilization technology was constructed in Futaba Town, and tests on multiple adsorption and stabilization technologies were conducted, as well as tests on the entire process from fly ash cleaning to adsorption and stabilization.

2) Evaluation of volume reduction technologies

Volume reduction technologies that underwent technical demonstration were classified based on their principles (classification technology, heat treatment technology, etc.), and then compared and evaluated individually according to four evaluation items (1) potential issues, (2) treatment effect, (3) treatment capacity, and (4) cost, and the results were presented to the Technology WG. This technology evaluation was not intended to evaluate each technology itself, but rather to provide reference for consideration of final disposal scenarios based on the results of the technology demonstration project.

For classification technology, conventional wet classification was evaluated as a technology that could be prioritized for consideration based on its treatment effectiveness, treatment capacity and cost. As for heat treatment technology, both melting and calcination were evaluated as having high treatment effectiveness and treatment capacity and potential for large-scale implementation. All chemical treatment technologies were evaluated as having issues such as the possibility of large-scale implementation. Regarding the cleaning process of fly ash cleaning technology, the mixed stirring method was evaluated as a technology that can be given priority consideration due to its high effectiveness in reducing radioactivity concentration. As for the adsorption process, both the mixed stirring method and the columnar method have been confirmed to be effective, and it has been decided to select a method based on the stabilization treatment method. For stabilization technology,

cement solidification would be adopted as the basic method based on the results of treatment of specified waste and safety assessments, and other solidification methods would be considered based on future results.

For products generated from volume reduction treatment with reduced radioactivity concentration, demonstration of managed recycling would be implemented.

3) Setting the amount and radioactivity concentration of removed soil and waste

In considering the final disposal scenario, the volume of removed soil and waste was set at approximately 14.85 million cubic meters, taking into account the volume already transported to the ISF by the end of FY2023, as well as the volume expected to arise from the Restricted Area in the future. The radioactivity concentration was estimated taking into account its change over time by the end of FY2024. The radioactivity concentration of removed soil arising from the Restricted Area after April 2024 was estimated based on the assumption that it would be similar to the radioactivity concentration distribution of removed soil generated in the Specified Reconstruction and Revitalization Base Areas by the end of FY2023. For the estimation of radioactivity concentration, the subject radionuclides were assumed to be Caesium134 and Caesium137. The volume of decontamination waste was estimated to be about 420,000 tons, taking into account the amount of waste treated at the temporary ash treatment facility by the end of FY2023, as well as the volume expected to be transported in the future based on the same concept as for removed soil.

4) Consideration on application and combination of volume reduction technologies

Based on the evaluation in 2), the application and combination of volume reduction technologies were considered. Since the characteristics of removed soil and ash generated from incinerating decontaminated waste (vegetation, etc.) (hereinafter “incineration ash”) differ, they were considered separately.

When the removed soil is transported to the ISF, it is sorted into two categories based on its radioactivity concentration at the time of transport: soil with a radioactivity concentration of 8,000 Bq/kg or less, and soil with a radioactivity concentration of more than 8,000 Bq/kg. For soil sorted into the category of more than 8,000 Bq/kg, concentration separation is initially implemented to separate that has decayed to 8,000 Bq/kg or less, and the application of volume reduction technology for soil of more than 8,000 Bq/kg was considered. For

volume reduction technologies, the possibility of applying classification treatment technology that can be introduced on a large scale at low cost, was first considered. For removed soil with relatively highly radioactivity concentration resulting from classification, the possibility of applying heat treatment technology, which is highly effective in reducing radioactivity concentration, was considered. For fly ash generated from heat treatment, the possibility of applying fly ash cleaning and adsorption technology was considered from the perspective of further volume reduction.

A policy was also considered for soil and waste with a radioactivity concentration of 8,000 Bq/kg or less after volume reduction to be used for managed recycling.

Incineration ash will be melted at the temporary ash treatment facility in the ISF, and methods were considered either to directly stabilize the resulting molten fly ash or to stabilize it after reducing its volume further followed by cleaning and adsorption treatment

5) Consideration of the Standard for Final Disposal

(Standard for landfill disposal of removed soil)

Based on the concept of radiation protection, the following seven key points for the draft standard for landfill disposal of removed soil were presented to the Technology WG.

(1) Prevention dispersal and runoff
(2) Prevention of groundwater contamination
(3) Preservation of the living environment (noise, vibration, etc.)
(4) Enclosure of the surrounding area and indication that the site is a landfill disposal site
(5) Closure of apertures
(6) Measurement of air dose rate (during construction, and during operation and maintenance)
(7) Recording and preservation of information on the location of landfill disposal, the amount of removed soil landfilled, and radioactivity concentration

The treatment standards for specified waste shall apply to waste with a high radioactivity concentration generated by volume reduction treatment and molten fly ash.

The draft standards stipulate that installation of waterproof sheets shall not be required in principle (disposal is carried out at a disposal site equivalent to a stable type site) when removed soil is disposed of by landfill, since amount of

radioactive caesium eluting from the removed soil is extremely small but if radioactive caesium is found to elute, waterproof sheets shall be installed around the site (disposal is carried out at a disposal site equivalent to a controlled type site).

In addition, in accordance with the treatment standards for specified waste, specified waste with a radioactivity concentration of over 100,000 Bq/kg shall be disposed of in a concrete-enclosed landfill site, and specified waste with a radioactivity concentration of 100,000 Bq/kg or less shall be disposed of in a controlled type landfill site.

The removed soil and waste to be finally disposed of are considered to be classified as very low-level waste or low-level waste under the IAEA Safety Standards, and the final report of the IAEA Experts Meeting assessed that the concept of final disposal at a near-surface disposal facilities is consistent with the IAEA Safety Standards. The amended Ministerial Ordinance including the standards for landfill disposal of removed soil and the related notification were promulgated in March 2025.

(Standard for volume reduction treatment of removed soil)
New provisions on concentration limits of wastewater and exhaust gas generated from volume reduction treatment of removed soil, new provisions were established based on the provisions on wastewater and exhaust gas generated from the treatment of specified waste. These provisions were submitted to the Radiation Council for consultation together with the draft standard for managed recycling, and the Council issued a report in February 2025 stating that the provisions are deemed appropriate. Amendments to the Ministerial Ordinance, including standards for wastewater and exhaust gas for volume reduction treatment of removed soil were promulgated in March 2025.

6) Proposal of multiple options for final disposal outside Fukushima Prefecture
From the above considerations, based on combination of volume reduction technologies, final disposal scenarios for removed soil and final disposal scenarios for waste (incineration ash) were considered, and four scenarios combining each of these were proposed.
<Final disposal scenarios for removed soil>
Removed soil with radioactivity concentration of 8,000Bq/kg or less will be used for managed recycling, and removed soil with radioactivity concentration of more than 8,000Bq/kg will be treated as follows:
(i) Radioactivity concentration sorting only
(ii) Classification in addition to radioactivity concentration sorting

(iii) Heat treatment in addition to radioactivity concentration sorting and classification
(iv) Fly ash cleaning in addition to radioactivity concentration sorting, classification and heat treatment

<Final disposal scenarios for waste (incineration ash) >

(i) Melting
(ii) Melting and fly ash cleaning

For these scenarios, the final disposal volume and radioactivity concentration were organized for each scenario, and options were compiled summarizing the structure and required area of the final disposal site. In addition, secondary waste generated during treatment was also organized for each scenario.

The overview of each scenario is shown in the figure below. The final disposal volume, radioactivity concentration, required area, and volume reduction treatment cost vary depending on the combination of volume reduction technologies. In scenarios (3) and (4), fly ash generated by the heat treatment of removed soil and its treatment products will be subjected to final disposal, meaning that all final disposal materials will be waste. The radioactivity concentrations (derived from soil) shown in the figure indicate the estimated radioactivity concentration of soil to be landfilled after the application of volume reduction technologies and waste derived from volume reduction treatment of soil for each scenario. The structure of the final disposal site varies depending on the final disposal materials and the radioactivity concentration, so three types of disposal site are listed.

	Scenario (1)	Scenario (2)	Scenario (3)	Scenario (4)
Combination of Volume Reduction Technologies	No volume reduction technology applied	Classification	Classification + Heat treatment	Classification + Heat treatment +Fly ash cleaning
Final disposal volume[1]	Approx 2.1 to 3.1 million m^3 <Breakdown> Removed soil: 2 to 3 million m^3 Waste: 0.1 million m^3	Approx 1.5 to 2.2 million m^3 <Breakdown> Removed soil: 1.4 to 2.1 million m^3 Waste: 0.1 million m^3	Approx 0.3 to 0.5 million m^3 <Breakdown> All waste	Approx. 0.05 to 0.1 million m^3 <Breakdown> All waste
Radioactivity concentration (Soil derived)	Several ten thousand Bq/kg	Several ten thousand Bq/kg	Several hundred thousand Bq/kg -	- Several ten million Bq/kg
Structure (Type of disposal site)	<(1) Removed soil> Covering soil Removed soil	<Waste(0.1million Bq/kg or less> Covering soil Surrounding area is covered with water-proof sheet, etc.	<(3) Waste (more than 0.1 million Bq/kg> Perimeter partitioning equipment of concrete structure	
Required space[*2]	Approx. 30 – 50 hectares	Approx. 30 – 40 hectares	Approx. 20 – 30 hectares	Approx. 2 – 3 hectares
Volume reduction cost[*3]				

*1 Based on the results of the technical demonstration projects that have been carried out to date, the volume reduction rate was set and calculated, and then converted to bulk density at the time of compaction. The quantities are rounded off for ease of comparison between scenarios.

*2 The thickness of the landfill for types (1) and (2) is 10m, and for type (3) it is 5m. The evaluation is based on the area required for the landfill only, and does not take into account factors such as the distance between the landfill and other facilities.

*3 In scenario (1), the cost of volume reduction treatment is zero because volume reduction technology is not applied, but the cost of volume reduction treatment increases as the application of volume reduction technology increases.

Figure: Multiple Options for Final Disposal Outside Fukushima Prefecture

7) Confirmation of the safety of final disposal scenarios through radiation safety assessment

In order to confirm the feasibility of final disposal of removed soil and waste from the perspective of radiation protection, the additional exposure dose (external exposure) of residents living in the vicinity of the final disposal site estimated for each final disposal scenario were evaluated, and it was confirmed that it would be 1mSv/ year or less.

Preliminary safety assessment conducted prior to this assessment, the exposure dose during the landfill disposal period, including transportation, and the operation and maintenance period, assuming three combinations of volume reduction treatments (1) classification only, (2) classification and heat treatment, and (3) classification heat treatment and fly ash cleaning. The type of disposal site was classified as inert type when only classification was implemented, and as isolated type when heat treatment and fly ash cleaning were also implemented. Assuming normal and accident conditions, evaluations were conducted of external and internal exposure of residents (adults and children) living in the vicinity during the landfill disposal period and after

disposal, as well as the groundwater migration after disposal. The results confirmed that the additional exposure from external exposure was the largest, and that the additional exposure dose from internal exposure was sufficiently smaller compared to that from external exposure. In addition, the additional exposure dose from external exposure was less than 1 mSv/ year. Moreover, a preliminary exposure assessment targeting strontium was conducted to understand the exposure effects of strontium during final disposal, and it was confirmed that the exposure effects were significantly smaller than those of radioactive caesium.

8) Transportation to the final disposal site

Concepts for transporting materials to the final disposal sites were organized based on the classifications according to the radioactivity concentration of materials subject to transport under the IAEA Transport Regulations and other regulations. In particular, for transporting materials classified as LSA-II, considerations will be given to measures such as storing the materials in containers that have been confirmed to meet certain test conditions, with reference to the standards for IP-2 Freight Containers. In addition, the possibility of marine transport was also considered, and the approach to transport was decided to be organized in the future.

9) Consideration of the approaches to communicate with local communities and framework of coexistence with local communities

Prior to the start of full-scale discussions on the practical implementation of final disposal beyond FY2025, necessary issues and concepts were identified regarding approaches to communicate with local communities and the framework of coexistence with local communities, based on discussion in the SALC WG.

(2) Status of achievement of the Technology Development Strategy goals and future challenges

Proposals were solicitated from private companies, universities, research institutions, and other entities, and small-scale demonstration projects were implemented. In addition, demonstration projects under national jurisdiction were implemented for heat treatment technologies and fly ash cleaning, adsorption, and stabilization technologies, and the results were utilized in the evaluation of volume reduction technologies. Furthermore, possibilities for utilizing products with reduced radioactivity concentration produced through volume reduction treatment were summarized based on small-scale demonstration projects and demonstration projects under national jurisdiction.

The evaluation of volume reduction technologies that have been demonstrated to date was reviewed, including from cost perspective. Based on this review of the evaluation of volume reduction technologies, multiple scenarios were considered by combining technologies, and the final disposal volume and radioactivity concentration for each scenario were summarized. Regarding the consideration of the standards for final disposal, the amended Ministerial Ordinance and related notifications, including the standards for landfill disposal of removed soil and the standards for wastewater and exhaust gas related to volume reduction treatment, were promulgated in March 2025.

Based on these results, options for the structure and required area of the final disposal sites were proposed in March 2025.

In addition, necessary issues and concepts were organized for the approaches to communicate with local communities and the framework of coexistence with local communities.

Going forward, while continuing to collect information and knowledge on the latest technologies and knowledge, it is necessary to consider the efficiency and cost reduction of volume reduction technologies, and the radioactivity concentration of waste subject to final disposal and social acceptance. It is also necessary to consider technical issues such as transportation methods and disposal site locations, as well as the end of special attention of the final disposal site.

(3) Approach beyond FY2025

Based on the results technology demonstration projects to date, technological development aimed at enhancing efficiency and cost reduction of volume reduction technologies will be continued. In addition, latest information and knowledge on volume reduction technologies will be compiled. Furthermore, the safe and efficient operation of the system as a whole will be considered for each combination of technologies envisaged in the final disposal scenario.

As for transportation to the final disposal site, consideration will be given to the type of containers to be used for transportation, taking into account the transportation standards for each radioactivity concentration classification.

Based on the above, consideration will be given to facilities for final disposal and transportation.

In addition, while organizing technical items related to the site conditions that should be considered when selecting candidate sites for final disposal, concepts

will be organized in terms of end of special attention of final disposal, such as under what conditions or what time period various measures based on the Act on Special Measures is no longer required.

Based on the multiple options for final disposal outside Fukushima Prefecture, full-scale discussions on approaches to communicate with local communities and framework of coexistence with the local communities, and the specific methods for considering the regions where the project will be carried out (practical implementation of the process of selecting candidate sites) will be held from FY2025. Based on these discussions, practical initiatives will be promoted to improve social acceptance in local communities regarding the final disposal of removed soil and waste. In conjunction with this consideration, examination will be conducted on changes in social acceptance according to the radioactivity concentration of the materials subject to final disposal, with a view to refining the final disposal scenario.

5. Fostering Nationwide Understanding

(1) Initiatives to Date

1) Initiatives on information dissemination and raising public awareness

Initiatives on information dissemination and raising public awareness aimed at gaining understanding of the necessity and safety of final disposal and managed recycling of removed soil and waste was carried out nationwide, including Fukushima Prefecture and the Tokyo metropolitan area.

As a way of communicating this information, site visits to the ISF and the agricultural land demonstration project (environmental restoration project) in Nagadoro District of Iitate Village were implemented, and to date, approximately 22,000 people have visited the ISF and approximately 4,400 people have visited the agricultural land demonstration project (environmental restoration project) in Nagadoro District of Iitate Village. Also, communication efforts were implemented, such as holding nine dialogue forums in regions from the Tohoku region excluding Fukushima Prefecture to the Kyushu region, roughly divided into nine blocks, where participants and speakers exchanged opinions. In addition, initiatives targeting next generation were implemented, such as lectures for university students, workshops, and tours planned by next generation themselves.

Furthermore, videos on environmental restoration initiatives created in collaboration with celebrities were viewed over 300,000 times. Additionally, exhibitions on environmental restoration initiatives were held at events in collaboration with other organizations that attracted many visitors, with some

events attracting approximately 4,500 visitors, and information dissemination through the media was also implemented.

2) Initiatives to enable experience of safety and peace of mind

During the site visits to the ISF and the agricultural land demonstration project (environmental restoration project) in Nagadoro District of Iitate Village, participants were given the opportunity to actually measure the air dose rate. Also, when explaining radiological data, pamphlets and other materials were used to provide explanations based on scientific evidence, and to facilitate with familiar risks such as natural radiation and medical exposure.

In addition, site visits to the agricultural land demonstration project (environmental restoration project) in Nagadoro District of Iitate Village began in FY2021, and explanation were provided using actual examples of managed recycling.

Furthermore, potted plants using removed soil were placed at a total of 23 facilities such as the Prime Minister's Office and relevant ministries and agencies outside Fukushima Prefecture.

3) Initiatives to promote the activities of a wide range of entities

Starting with lectures to approximately 5,800 students at educational institutions such as high schools and universities in 26 prefectures, including the Tokyo metropolitan area and the Kansai region, lectures were held in collaboration with junior high schools, high schools and universities in various regions, as well as site visits and workshops.

Also, an award program was implemented to provide students to think about the future of Fukushima and expanding connections between students through new ideas. To date, a total of 989 entries (until FY 2024) have been submitted from junior high school students, high school students, and university students, contributing to the promotion of student activities.

(2) Status of achievement of the Technology Development Strategy and future challenges

1) Initiatives for information dissemination and raising public awareness

To date, various initiatives have been implemented, including exhibitions at events held in collaboration with other organizations, utilization of social media, and site visits.

Among these initiatives, a questionnaire survey of participants revealed that the majority of respondents had positive responses regarding the safety and necessity of managed recycling, as sell as pros and cons. Of these, there was a tendency toward greater understanding, sympathy, and acceptance, as evidenced by the fact that the percentage of positive responses regarding the necessity and safety of managed recycling was significantly higher in the questionnaire for initiatives with 50 or fewer participants than those with several hundred to several thousand participants.

2) Initiatives to provide a sense of safety and peace of mind.

For the site visits, efforts were made to provide opportunities to actually experience measuring the air dose rate and to explain the actual cases of managed recycling. In the questionnaire survey of the participants in these initiatives, more than 80% of respondents expressed positive opinions about safety, demonstrating the effectiveness of these initiatives in providing a sense of safety and peace of mind.

3) Initiatives to promote activities by a wide range of entities

In addition to the site visit workshop organized by the MOE Japan in collaboration with universities, initiatives to support voluntary activities by universities were also implemented. A questionnaire survey of participants in the site visit workshops showed that the percentage of positive responses regarding the necessity, safety and pros and cons of managed recycling was higher than those for other initiatives to foster understanding, indicating that these initiatives tended to highly effectiveness in promoting understanding, empathy and acceptance.

4) Summary of achievements and future challenges

As described above, although progress has been made to a certain extent in each of the initiatives to foster understanding, a nationwide online survey conducted from FY 2018 to FY 2024 showed that overall awareness of the policy of final disposal outside Fukushima Prefecture remained largely unchanged, at around 50% within Fukushima Prefecture and 20% outside Fukushima Prefecture. Notably, the percentage of respondents who had never heard of the policy of final disposal outside Fukushima Prefecture tended to be particularly high among the next generation. Also, there was an increase of positive responses regarding the necessity of managed recycling, safety, as well as pros and cons, indicating a growing trend toward understanding, sympathy, and acceptance.

Based on these results, although a certain degree of progress has been made in fostering nationwide understanding and trust and gradual expansion and deepening of social acceptance, it is necessary to continue implementing measures to further advance these efforts. In particular, raising public awareness and understanding is an issue that needs to be addressed, and efforts to raise public awareness and understanding needs to promoted, especially among the next generation. Furthermore, in addition to raising public awareness and understanding, expanding and deepening social acceptance is an issue that needs to be addressed in order to realize final disposal and promote managed recycling. To this end, it is necessary to consider the targets, content, measures for fostering public understanding.

(3) Approach beyond FY2025

In order to realize the final disposal of removed soil and waste and promote managed recycling, continuous efforts will be made to foster public understanding and trust regarding the necessity and safety of these measures, with a particular focus on gradually expanding and deepening social acceptance among local governments and local residents.

For the time being, (1) efforts will be made to raise public awareness and interest in the necessity of final disposal and managed recycling of removed soil and waste, (2) deepen understanding and empathy for the necessity and safety of final disposal and managed recycling among those who are aware of or interested in, and (3) provide easy-to-understand explanations of managed recycling based on scientific evidence, including the content of amended ministerial ordinances and guidelines, and to promote initiatives to improve social acceptance, such as providing opportunities to visit the actual managed recycling sites.

The following two surveys are considered as reference for monitoring the progress of these objectives.

・Surveys to measure trends in changes in public awareness

Consider methods to measure trends in changes in public awareness regarding final disposal and managed recycling, such as online surveys, surveys to measure awareness of radiation risk, and monitoring media coverage of the MOE Japan’s initiatives, and use these methods to assess progress toward the initiative targets. When doing so, ensure that trends for each target group, such as by age and region, are captured.

・Questionnaire surveys of participants in initiatives to foster understanding.

Conduct questionnaire surveys for participants in various initiatives to fostering understanding, implemented by the MOE Japan, and use the results to improve the implementation of such initiatives. When conducting the questionnaire surveys, pay attention to setting common questions across various initiatives so that the effects of initiatives for fostering understanding can be compared.

To achieve the objectives, advance initiatives to fostering public understanding, taking into account: the target audience, content, methods and creative approaches for communication related to such initiatives.

(Target audience)

Promote initiatives to foster understanding among the general public by providing detailed information on the necessity and safety of final disposal of removed soil and waste, responding to concerns and worries about the effects of radiation, and to dispel harmful rumors.

In particular, efforts will be made to foster understanding toward the next generation, who will gradually become the active members of society by 2045, as well as toward relevant ministries, agencies and local governments that will be responsible for implementing public works projects, and toward highly influential parties such as mass media, education professionals, and celebrities.

In addition, information dissemination will be carried out to overseas media and international organizations in order to foster understanding overseas.

Furthermore, it is also important to provide accurate information on removed soil to workers involved in construction work, who will be directly involved in final disposal and managed recycling projects.

It is also necessary to change the target audience flexibly in accordance with the progress of final disposal and managed recycling initiatives.

(Content for communication)

When explaining the necessity of final disposal and managed recycling, as well as the safety based on scientific evidence in a easy-to-understand manner, it is important to use the standards for managed recycling, knowledge gained from managed recycling demonstration projects, and the assessments by the IAEA. The following are the contents for communication.

- Necessity of final disposal and managed recycling

- ✓ In addition to explaining the status of the interim storage project, explanation of the background and thoughts of the local communities, including the fact that the transport of removed soil and waste to the ISF is progressing and the TSS located throughout the prefecture are being dissolved, due to the very difficult decisions to accept the ISF made by the towns of Okuma and Futaba, and that this has led to significant progress in the reconstruction of the entire Fukushima Prefecture.
- ✓ Explanation of the fact that the key to the realization of final disposal is to promote managed recycling.

➢ Definitions and details of final disposal and managed recycling

- ✓ Standards for managed recycling and landfill disposal, and details of the guidelines
- ✓ Details of multiple options for the structure and required area of final disposal sites

➢ Safety of final disposal and managed recycling

- ✓ Radiation risks associated with final disposal and managed recycling, compared to familiar risks such as natural radiation, medical exposure and factors other than radiation
- ✓ Dose criteria (additional exposure dose) for managed recycling to be set at 1 mSv/year or less, and based on this, criteria for radioactivity concentration of removed soil processed into recycled materials (8,000 Bq/kg or less)
- ✓ In addition to ensuring that the additional exposure dose is 1 mSv/year or less, managed recycling shall be implemented under appropriate management, including covering with soil and other materials to prevent dispersal and runoff of removed soil processed into recycled materials, and monitoring
- ✓ Half-life of radioactive caesium, and its strong adhesion to soil
- ✓ Radioactivity concentration of nuclides other than radioactive caesium (same level before and after the accident)
- ✓ Findings from managed recycling demonstration projects (no significant change in air dose rate before and after the construction of the demonstration projects)
- ✓ Assessment by the IAEA (MOE Japan's initiatives for final disposal and managed recycling to date are in line with IAEA safety standards)

➢ To dispel harmful rumors at locations where projects will be implemented, disseminate information on safety based on actual project data, taking into account the progress of final disposal and managed recycling initiatives.

(Methods of communication)

The policy on initiatives to foster public understanding will be to raise awareness and understanding of the necessity of final disposal and managed recycling among as many people as possible through the dissemination of information, and to increase the number of participants in initiatives that focus on site visits and interactive dialogue, which are highly effective in fostering understanding, with the aim of encouraging participants recognize the issue as their own.

- Initiatives to raise awareness and interest
  - ✓ Dissemination of information via social media, websites, pamphlets, etc.
  - ✓ Advertising
  - ✓ Participation in events within and outside Fukushima Prefecture in collaboration with other organizations
  - ✓ Effective use of PR facilities
  - ✓ Implementation of an awards system for students

- Initiatives to deepen understanding of the necessity and safety of the project and to gain sympathy from those who are aware of or interested in the project
  - ✓ Conducting site visits to the ISF and the agricultural land demonstration project (environmental restoration project) in Nagadoro District of Iitate Village (in particular, for target audiences such as the next generations and local government officials, in order to maximize the effectiveness of efforts to foster understanding, providing explanation of the environmental restoration initiatives prior to the site visit and provide opportunities for interactive dialogue after the visit, when necessary).
  - ✓ Lectures, site visits and workshops for students
  - ✓ Implementation of initiatives centered on interactive dialogue (consideration will also be given to initiatives to disseminate the outcomes of these initiatives to a wide audience)
  - ✓ Providing opportunities for the next generation involved in events organized by the MOE Japan to interact with their peers and disseminate information to a wide audience.

- Initiatives to enhance social acceptance of managed recycling
  - ✓ Initiatives centered on interactive dialogue with a focus on enhancing social acceptance.
  - ✓ Implement initiatives that enable people to recognize the necessity and safety of managed recycling.

(Creative approaches for communication)

The following creative approaches will be implemented to foster understanding.

- Concise, easy-to-understand, objective expressions
  - ✓ Preparation of materials for clear and concise communication.
  - ✓ Consistent use of units and standardized terminology.
  - ✓ Dissemination of accurate, easy-to-understand information based on scientific evidence.
  - ✓ Explanation of radiation risks in comparison with familiar risks

- (Based on objective information) Creative expressions to enable easy understanding
  - ✓ First, disseminate information based on the background and thoughts of the local communities through explanations by officials, regarding the necessity of final disposal and managed recycling.
  - ✓ Step-by-step information dissemination, taking into account the progress of initiatives of final disposal and managed recycling of removed soil and waste, starting with information that is likely to attract the interest of the general public (e.g. information on the charms of Fukushima), followed by information on the necessity of final disposal and managed recycling, and then explanation on safety.
  - ✓ Flexible implementation of dialogue based on the concerns and worries of the audience
  - ✓ Requesting the next generation who participated in events to participate and cooperate in various events related to environmental restoration organized by the MOE Japan, and disseminate information through them.

- Initiatives to maximize the effectiveness of efforts to foster understanding, etc.
  - ✓ To maximize the effectiveness of initiatives to foster understanding, provide explanations on environmental restoration in advance and ensure opportunities for interactive dialogue after site visits, when necessary.
  - ✓ Implementing accurate and easy-to-understand explanations and dialogue based on scientific evidence by MOE Japan officials and experts to foster understanding and trust.

6. Conclusion

It is the responsibility of the national government, as stipulated in the law, to "take the necessary measures to complete final disposal outside Fukushima Prefecture within 30 years of the start of intermediate storage". Toward the realization of final disposal outside Fukushima Prefecture, initiatives will be steadily promoted based on three pillars: "promoting managed recycling", "consideration of the direction of final disposal", and "fostering nationwide understanding".

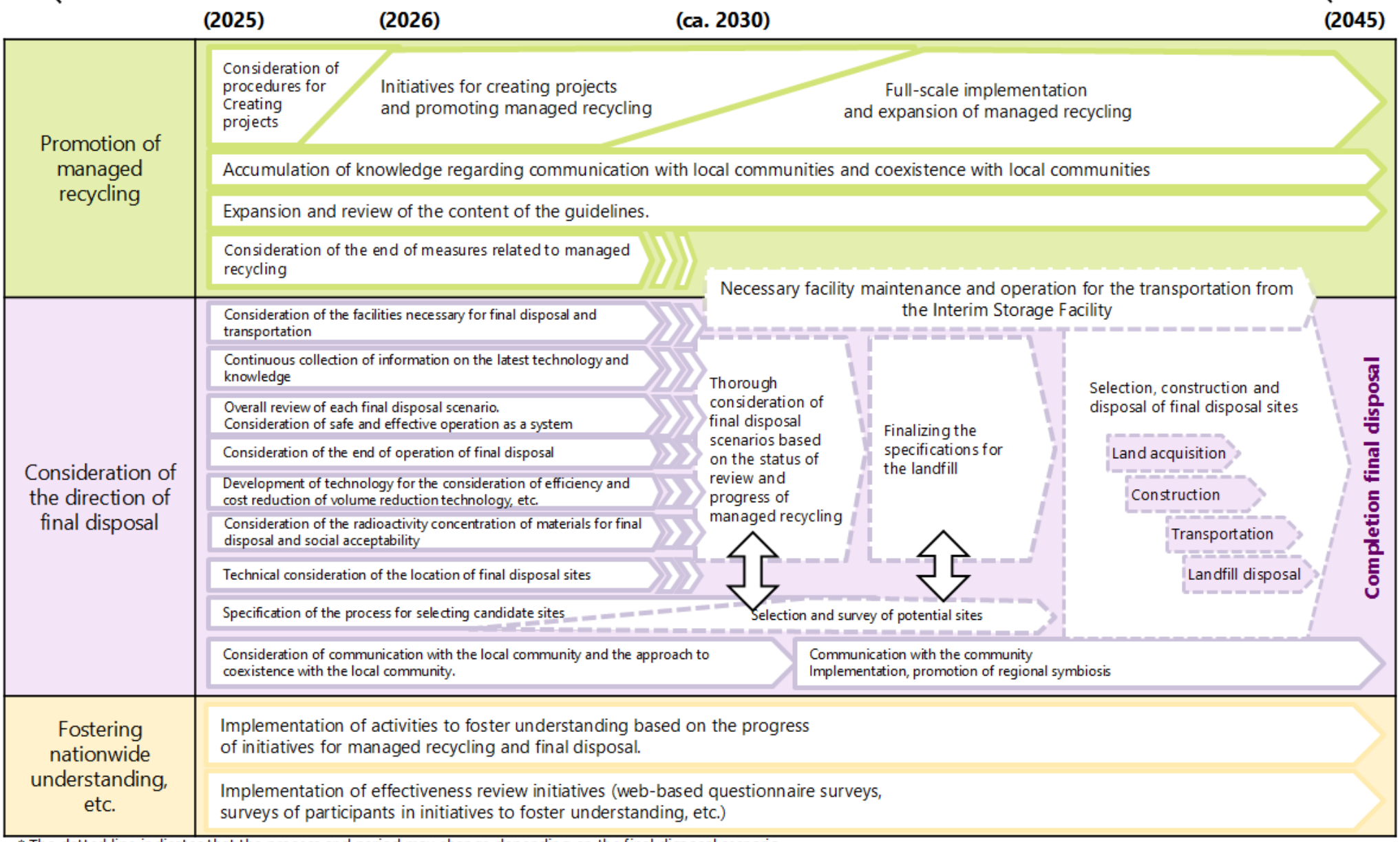
In order to proceed with future initiatives, it will be necessary to refine the final disposal scenarios while also conducting technical studies and assessing the social acceptability of each scenario for final disposal. To this end, discussions on final disposal outside Fukushima Prefecture will be deepened based on initiatives to foster nationwide understanding, with consideration of technical and social perspectives in tandem. Beyond FY2025, initiatives will be made based on this approach and the attached materials, but the status of these initiatives will be reviewed in a timely manner, and this approach will be revised when necessary.

In addition, taking advantage of the Promotion Council, promotion of initiatives on managed recycling and fostering nationwide understanding will be continued in a unified manner within the government, and information will continue to be disseminated steadily both domestically and internationally, while receiving follow-up from the IAEA.

This approach focuses on the process from Step 4 to Step 5 of the eight steps toward final disposal outside Fukushima Prefecture as indicated in the document "Response to the ISF", but maximum efforts will be made continuously toward Step 6 and beyond, including the development of a final disposal site, transportation to the final disposal site, and completion of final disposal.

Appendix

Approach beyond FY2025 for final disposal of removed soil, and waste outside Fukushima Prefecture.



* The dotted line indicates that the process and period may change depending on the final disposal scenario.
* The project in the Nagadoro District of Iitate Village will be continuously monitored, etc., and will be used as a venue for fostering understanding with the cooperation of the local community.
* The implementation of projects to foster understanding will also be considered.
* The use of the site of the Interim Storage Facility, will also be considered.
* The progress of the above initiatives will be followed up by the IAEA and disseminated internationally.