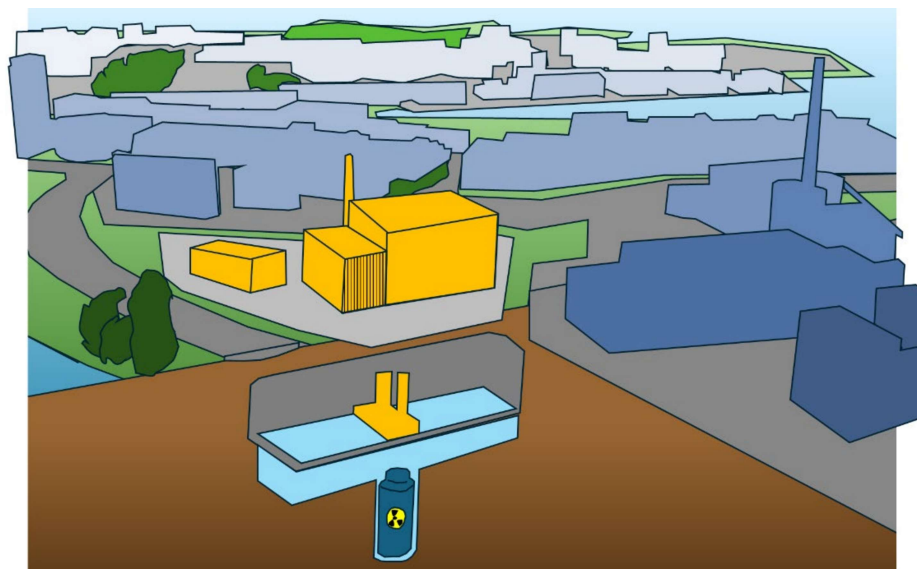


RESEARCH REPORT

VTT-R-00072-26/EN



Licensing and ensuring the safety of small modular reactors

A guide to support municipal decision-making and project preparation

Authors: Keto Paula¹, Airola Merja¹, Naumer Sami¹, Gotcheva Nadezhda¹, Kiviluoma Niina², Käis Maare², Kojo Matti², Lammi Hanna¹

¹ VTT Technical Research Centre of Finland Ltd

² LUT University

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Summary Small Modular Nuclear Reactor (SMR) technology is a new alternative for municipalities to produce carbon-neutral energy. Depending on the type of reactor and capacity, SMRs can be used for producing district heating, electricity or both. This often puts municipalities and municipal energy companies in a new situation – project development must take into account the requirements that regulate ordinary construction projects and also the requirements of the Nuclear Energy Act concerning site selection and licensing of a nuclear facility. The purpose of this guide is to give municipalities, municipal decision-makers and future project developers a better understanding of the entire life-cycle of SMR plant projects and what they should take into account as the project progresses. At the time of writing this guide, the Finnish Nuclear Energy Act and the Land Use Act have been reformed, and the information presented in the guide related to planning and licensing under the Nuclear Energy Act are based on the drafts of these laws. For this reason, up-to-date information and official instructions must always be verified directly from the responsible authorities. However, this guide can be used as preliminary information to support project preparation and decision-making. The licensing process for projects under the Finnish Nuclear Energy Act progresses in phases, including the decision-in-principle for the nuclear facility, the construction license and the operating license. In addition, an SMR plant project requires an environmental impact assessment (EIA is a requirement for the construction license and the strategic environmental assessment (SEA) is part of the decision-in-principle) and other permits. A sufficiently large precautionary action zone, emergency planning zone, site-specific risks and other predetermined selection criteria, such as the distance to the electricity or district heating network, must be taken into account during site selection and planning related to each nuclear power plant. It is recommended that the surveying, comparison and final selection of suitable sites be carried out in stages. The license applicant's responsibility is emphasised in terms of commissioning the necessary reports related to the project. Based on the reports, the Radiation and Nuclear Safety Authority (STUK) assesses whether the site meets the requirements set for it in the Nuclear Energy Act. There are several possible organisational models for SMR plant projects. From the project aspect, important elements include the nuclear energy competence possessed by the project developer and especially the license applicant, a good safety culture, long-term commitment and sufficient financial resources. The license applicant may be a municipal energy company, a larger consortium or a national energy company/service provider. The nuclear power plant operator could also be a separate operator responsible for the safe use of the reactor. Owners can be a municipality, a joint municipal authority or an energy company. The supplier of the reactor is responsible for the reactor technology that they sell. The license applicant is also responsible for organising nuclear waste management and for the related costs. Nuclear waste management can be organised by the license applicant or, subject to certain conditions and commercial agreements, the waste management obligation can be transferred to another party. In particular, centralised waste management is recommended for spent nuclear fuel and high-level waste in order to ensure sufficient expertise and competence. The use of nuclear power requires that the nuclear power plant has been designed to be safe, is safe to operate, and has effective plans for emergency situations. The use of nuclear power in municipalities must also be socially acceptable. This means that the license holder and the municipality both communicate about the preparation and progress of the project as openly and comprehensively as possible and ensure that residents have opportunities to	



participate, engage in dialogue and exert influence throughout the project preparation and the entire life cycle of the facility. In general, support for SMR is currently at a good level in Finland, and a resident survey indicates that the majority of city residents also have a positive attitude towards SMR. However, approval decreases when power plants are located in a person’s own municipality and especially in their immediate surroundings. Safety and nuclear waste management solutions often divide opinions, and people value open communication and opportunities to participate in decision-making.

In terms of nuclear waste management, additional communication and dialogue concerning the different options for organising waste management are needed.

This is a translation of the original research report; in the event of discrepancies, the original version shall prevail.

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Date:	14 July 2026
Signature:	DocuSigned by: Arto Laikari 50414DA96A18416...
Name:	Arto Laikari
Title:	Research Team Leader

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Preface

This guide was compiled at VTT (Espoo, Tampere) and LUT University (Lappeenranta) during 2025 and January 2026. The translation of the document from Finnish to English was done during May 2026 by Lingsoft Oy. The guide is part of the SMR Siting and Waste Management SMRSiMa project funded by SAFER2028. The main authors were Merja Airola, Paula Keto, Sami Naumer and Nadezhda Gotcheva from VTT as well as Niina Kiviluoma and Matti Kojo from LUT University. We would like to thank the Ministry of Economic Affairs and Employment (MEAE), the Ministry of the Environment, the Radiation and Nuclear Safety Authority (STUK), Finnish Energy, the regional councils, Helen, Steady Energy and many other actors that provided us with feedback. We would especially like to thank Jussi Heino and Janne Nevalainen from the Radiation and Nuclear Safety Authority for reviewing the report and Annina Alasaari from Energy Finland for collecting the feedback and the invitation to a workshop on land use planning and zoning related to SMR.

The cover image was produced by Sami Naumer.

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Paula Keto, Merja Airola, Sami Naumer, Nadezhda Gotcheva, Niina Kiviluoma, Matti Kojo and Hanna Lammi



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1 Introduction

Discussion on the use of nuclear energy and increasing its production is active on an international level. This discussion is driven by targets related to climate change mitigation, such as reducing the use of fossil fuels, achieving emission reduction targets and enabling the electrification of societies. Finland's current government programme also highlights nuclear energy as one solution for reducing the climate impacts of energy production.

Finland currently has five operational nuclear power plants that produce enough energy to meet 40% of the country's electricity needs. The nuclear power plants are located in Olkiluoto (OL1, OL2, OL3) in Eurajoki and in Loviisa (LO1, LO2). In addition, Posiva is in the final stages of introducing a final disposal repository for spent nuclear fuel in Olkiluoto. Final disposal of low- and intermediate-level waste (LILW) in Finland has been organised in Olkiluoto and Loviisa since the 1990s.

In addition to conventional large-scale nuclear power plants, a lot of discussion has focused on various Small Modular Reactors (SMRs) that are in the development phase. By definition, these are nuclear power plants with a power output of less than 300 megawatts. In Finland, special attention has been paid to SMRs intended for heat production as an option for producing district heating in cities. SMRs differ from large nuclear power plants in terms of their size, applications, safety solutions and possible remote use. On the other hand, SMRs may be very different in terms of size, technical implementation and intended use.

The purpose of this guide is to provide information on SMRs in a non-technical manner. The guide describes operating principles, applications, the Finnish licensing process under the new Nuclear Energy Act, land use planning and zoning in accordance with the Land Use Act, organisation of nuclear waste management, and special features related to commissioning and operation. The guide also deals with how to ensure the safety of nuclear power use. Finally, it presents an overview of the social acceptability of nuclear power. The guide is particularly intended for Finnish decision-makers and office holders in cities and municipalities, city residents with an interest in the use of nuclear power and future project developers.

AI has been used while compiling the report to increase fluency and assist with the search for material. However, the material used has always been checked from the original source and no AI summaries have been used in the text.

It should be noted that the content of the guide is based on drafts of the new Nuclear Energy Act and Land Use Act, which means that municipalities and project developers must always check the up-to-date legislation and instructions directly from the relevant law and the contact authorities.

2 Situation of SMR projects in Finland, applications and technology

2.1 Current situation related to SMR projects in Finland

In Finland, SMRs have been a prominent feature in discussions during recent years. It has been seen as a way of reducing carbon emissions from energy production, especially in district heating production. Finnish energy companies have investigated the use of SMR, while new SMR actors have simultaneously emerged on the Finnish market. This chapter summarises the most important reports and plans related to SMR in Finland.



Fortum's nuclear power feasibility study

In 2025, Fortum published the conclusions of its comprehensive nuclear power feasibility study. The study also addressed the use of SMR as part of energy production. According to the study, both small and large nuclear power plants have a role to play and advantages in terms of energy production. Among other things, the advantages of SMRs were considered to be the possibility of locating them closer to industrial areas and using them for heat production in cities and certain industrial sectors. The potential challenges were seen as the higher unit price of SMRs if they are not built in large numbers and uncertainties related to new technologies. As a general conclusion, the report also stated that nuclear power will not be built on a fully merchant basis. Instead, financing and risk-sharing mechanisms are needed.

In early 2026, Fortum announced an investment of EUR 2 million in the development of Steady Energy's district heating reactor. Fortum and Steady Energy have also signed an agreement under which Fortum can support reactor development work and produce the operation and maintenance services required by the power plants in the future.

Sources and additional information:

- [We develop nuclear as a future option | Fortum](#)
- [Fortum concludes new nuclear feasibility study – continues to develop nuclear as a future option | Fortum](#)
- [Fortum deepens its collaboration with Steady Energy, a developer of district heating reactors | Fortum](#)

Outokumpu study on SMR

One of Outokumpu's goals is to reduce carbon emissions from steel manufacturing. Outokumpu completed its study on SMR in 2025. According to the study, SMR based on existing light water technology would be suitable for producing the low-carbon energy needed by the company. However, Outokumpu's plans do not include functioning as an SMR license applicant or license holder (see Chapter 3.3 below) and the company is looking for an external partner for the project.

Sources and additional information:

- [Outokumpu has finalized study on emerging nuclear technology, seeks external investors to complete the project | Outokumpu](#)

Kuopion Energia's SMR project

The Kuopion Energia SMR project is based on the need to find a new, emission-free and cost-effective form of heat production as the Haapaniemi power plant will reach the end of its life cycle by 2035. The preliminary plan involves investigating the construction of two 50 MW SMR units that would only produce heat. The facility structure would be simpler than conventional large nuclear power plants, and most of the production facilities would be located underground in the bedrock. Construction is estimated to last for approximately 3.5 years, and construction could begin in the early 2030s. Kuopio has carried out investigations and preparatory planning in cooperation with Steady Energy Oy. Preparations for the Environmental Impact Assessment (EIA) began in early 2025. The aim was to launch the EIA process in March 2025 for the most interesting sites (Hepomäki and Sorsasalo) identified in the site investigation process. The official EIA process and constructability investigation began in May 2025 when Kuopion Energia and AFRY Finland Oy signed an agreement on EIA and a constructability investigation.

**Sources and additional information:**

- [Pienydinvoima - Kuopion Energia](#) (Only in Finnish)

Helen's nuclear energy programme

Helen Oy is an energy company owned by the City of Helsinki that is responsible for electricity and heat production, district cooling and electricity transmission. The company's goal is to produce carbon-neutral energy by 2040. In 2024, Helen had a turnover of approximately EUR 1.5 billion and an average of 777 employees. The company's electricity sales totalled 5,283 GWh, electricity transmission in Helsinki was 4,571 GWh, heat sales 5,981 GWh and cooling sales 244 GWh.

According to Helen's nuclear energy programme launched in 2024, the target is to build SMRs to produce combustion-free heat. In the first phase, Helen is looking for a site for a single power plant that would be either a heat-only plant or a plant type that would produce both electricity and heat with a total output of 500 MW. In November 2025, the nuclear energy programme selected three potential sites for more detailed investigations: the Vuosaari and Salmisaari power plant areas and the Norrberget area located in western Östersundom. An environmental impact assessment procedure for these site options began at the end of 2025. Helsinki is also preparing to start land use planning and zoning at these sites. In January 2026, Helen established a separate company for nuclear power project development. Helen Nuclear Ltd is wholly owned by Helen Oy, and its task is to examine the prerequisites for constructing nuclear energy production in Helsinki and prepare the project for an investment decision.

Sources and additional information:

- [Nuclear energy | Helen](#)

Steady Energy's SMR

Steady Energy is a VTT spin off. VTT and Steady Energy are developing the LDR-50 district heating reactor. (Read more about district heating reactors in Chapter 2.2 below). The reactor has a low power output and is based on passive safety solutions, which is why its placement near cities or industry is considered possible. Steady Energy has signed letters of intent with Kuopion Energia, Helen and Keravan Energia concerning the design of nuclear district heating. Steady Energy is building an SMR pilot project in the Helen turbine hall. The reactor in the pilot project is a full-scale replica of a real reactor, but it will not use nuclear fuel. The purpose of the pilot is to test district heating production in a full-scale reactor located in a real environment, and to verify that the plant's safety systems function as planned.

Radiation and Nuclear Safety Authority STUK assessed the conceptual design of the LDR-50 reactor in summer 2025. The assessment focused on areas such as the facility-level design basis, safety functions and radiation safety. Among other things, the report stated that the plant's passive safety systems are favourable in terms of safety. However, the report also states that the impact of, for example, human factors on safety has not been taken into consideration. The plant received praise regarding its preparedness for serious reactor accidents, even though such accidents should not be possible in the plant concept.



Sources and additional information:

- [Steady Energy](#)
- [STUK's safety assessment of LDR-50 reactor conceptual design](#)

Calogena's SMR

Another company that is designing a district heating reactor for the Finnish market is the French company Calogena. The Calogena reactor is also a low power output reactor designed only for heat production. Calogena's SMR is part of Kuopion Energia's environmental impact assessment process. Calogena intends to build a pilot reactor in the near future, the planned site of which is the Cadarache research centre in France. STUK prepared a preliminary assessment of the CAL-30 reactor in 2025, and this can be used in the reactor development phase.

Sources and additional information:

- [Main page - Calogena](#)
- [Heating SMR to be assessed for Cadarache site - World Nuclear News](#)
- [Small modular reactors | Radiation and Nuclear Safety Authority STUK](#)

2.2 SMRs and basic operating principles for the technology

Well over 100 different SMRs are already being designed ([NEA Small Modular Reactor Dashboard](#)). The operating principles of the reactors can be divided into four main categories: reactors that use light water, gas, liquid metal and molten salt as coolants. The advantages of the reactors that are not cooled with light water include higher operating temperatures (gas-cooled reactors) or different or new fuels, such as the reuse of spent fuel in the reactor fuel (some reactors that are cooled with liquid metal or molten salt). However, the reactor concepts are partly based on new technologies, which means that a lot of research and development work will still be required before these reactors could be deployed in Finland. As a result, this guide focuses on models based on light water reactor technology, because they are expected to be the first SMRs deployed in Finland. Their technology is based on the nuclear power plants that are currently in use worldwide. The Radiation and Nuclear Safety Authority's publication contains a good and clear summary of different reactor types in Finnish, which provides more information about the features of different technologies ([Preconditions for the safe use of small modular reactors](#)). Definitions related to nuclear plants are presented in Table 2-1.

In the same way as the reactors currently used in Finland, electricity and heat production in light water cooled small modular nuclear reactors (LWR SMR) is also based on fission taking place in the uranium fuel. The enriched Uranium-235 nucleus in the uranium fuel splits to produce daughter nuclei, neutrons and energy. The cooling water heats up, vaporises and rotates the turbine to generate electricity. In a pressurised water reactor, the water in the primary circuit heats and vaporises the water in the secondary circuit, after which the resulting steam is led to the turbine. In a boiling water reactor, the water that cools the reactor vaporises directly and is led to a turbine in the same circuit. However, SMRs designed for heat generation, such as Steady Energy's LDR-50 or Calogena's CAL-30, act as an exception, as they have no turbine and heat is extracted using a heat exchanger.

LWR SMRs also differ from existing power plants in some ways. As mentioned earlier, they have lower power outputs than existing power plants. Electrical power is typically limited to 300 MW_e (800–



1,000 MW_{th} heating power), while the corresponding numbers for existing plants operating in Finland are 500–1,600 MW_e (1,500–4,300 MW_{th}). The heating power in reactors that only produce heat is even lower, for example, 30–50 MW_{th} in the Calogena and LDR-50 models. The low power levels mean that many LWR SMRs can utilise passive safety functions. These include natural coolant circulation and passive removal of residual heat without pumps or the need for electricity. Especially in lower power reactors intended only for heat production, residual heat removal can function for long periods of time without additional measures.

Due to the smaller amount of nuclear fuel, lower reactor power, operating pressures and passive safety characteristics, it has been estimated that SMRs could be located closer to the urban environment. However, the safety of SMRs – also in urban areas – must be ensured by comprehensively examining each SMR separately. A site closer to the urban environment would make it possible to produce district heating using SMRs, as heat production would be near existing district heating networks. A precautionary action zone is defined for the reactor(s), and more information about this is provided in Chapter 3.

Radioactive waste is always generated when energy is produced using nuclear power. This waste includes high-level waste, which is mainly spent fuel, as well as low- and intermediate-level waste, such as activated reactor materials, radioactive liquids collected from the plant and very low-level waste, which includes radioactively contaminated personal protective equipment. More information on managing these types of waste is provided in Chapter 3.11.

Table 2-1. Definitions related to nuclear power plants.

Nuclear facility (ydinlaitos)	A nuclear power plant, nuclear technical facility, final disposal facility for nuclear waste, or nuclear fuel production plant.
Nuclear power plant (ydinvoimalaitos)	A nuclear facility intended to generate electricity or heat by means of a nuclear reactor based on nuclear fission.
SMR (pieni modulaarinen ydinreaktori)	Small Modular Reactor
Nuclear reactor (ydinreaktori)	The part of the nuclear power plant where the nuclear fuel is located and a nuclear reaction takes place. The heat released during the reaction heats the water, which leads the resulting steam to a turbine for electricity production or to a heat exchanger for heat production.
Light water reactor (kevytvesireaktori)	A light water reactor is a nuclear reactor in which ordinary water is used as the coolant and neutron moderator. Finland's existing nuclear power plants use light water, and its first SMRs are expected to be light water reactors.
District heating reactor (kaukolämpöreaktori)	An SMR that only produces heat.
Radioactive waste (radioaktiivinen jäte)	Waste generated in a nuclear power plant or elsewhere that decays radioactively.
Spent fuel (käytetty polttoaine)	Nuclear fuel that has undergone fission in the reactor. High level and long-lived radioactive waste.



3 SMR site selection, land use planning and zoning, and licensing under the Nuclear Energy Act

3.1 Introduction

The construction and operation of a nuclear power plant involves a number of official processes to ensure safety, social acceptability and regulatory compliance. The licensing of a nuclear facility proceeds according to the phases specified in the Nuclear Energy Act. Site selection for the facility is guided by its purpose and size (e.g. a SMR for heat production or a larger nuclear power plant for electricity production), the requirements laid down in the Nuclear Energy Act and STUK regulations, as well as international standards (IAEA 2025) and land use planning and zoning.

Land use planning and zoning related to a nuclear facility proceeds as a separate process in accordance with the Land Use Act. The municipality is responsible for the local land use plan. In some cases, the nuclear power plant must also be taken into account in the regional land use plan. In the early phases of the project, land use planning and zoning as well as other planning and licensing procedures for the nuclear facility may proceed **in parallel** (Figure 3-1). However, applying for a construction license under the Nuclear Energy Act requires that a site has been selected for the plant, an environmental impact assessment has been performed, STUK has evaluated the site and issued a statement on it, and the municipality has approved the land use plan (the decision does not have to be legally valid at this time). Even if the facility already has a construction license in accordance with the Nuclear Energy Act, construction cannot begin until the facility also has the other required permits.

This chapter provides a general overview of these key processes. **More detailed and up-to-date instructions are always available from the contact authority.**

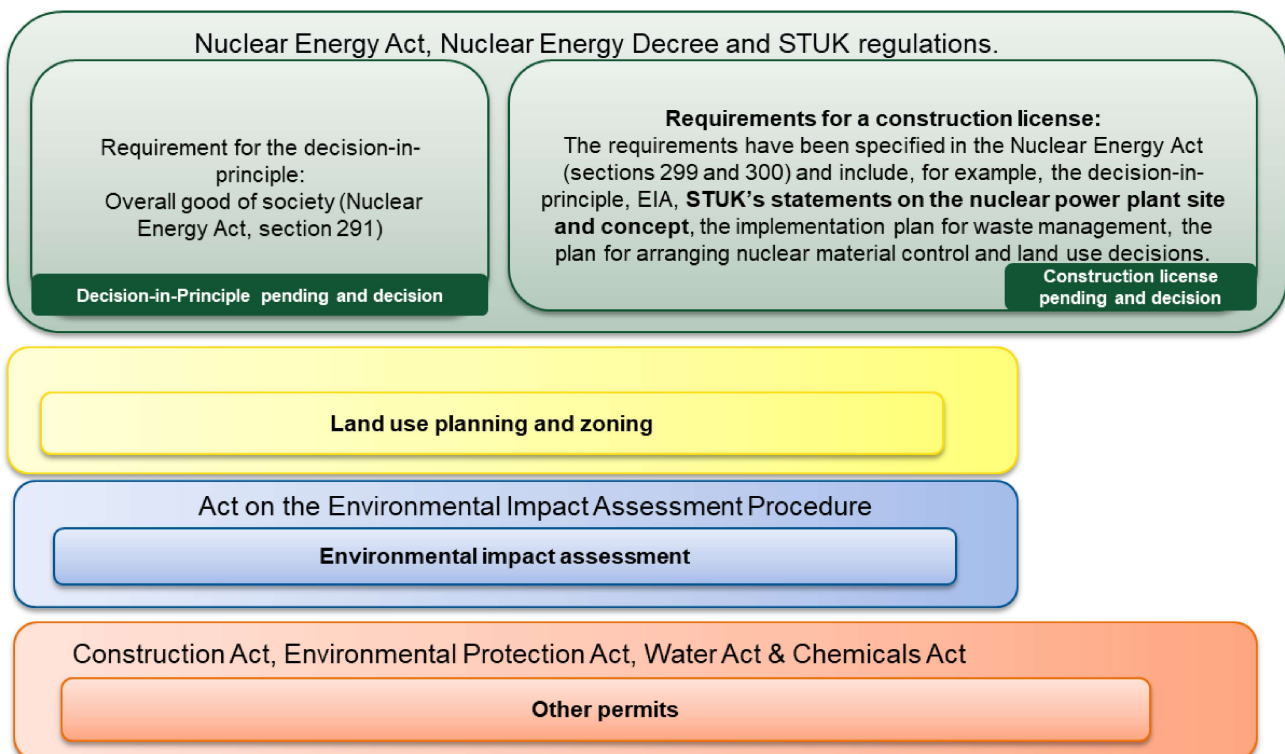


Figure 3-1. Laws that must be taken into account during preparation of a nuclear power plant project.



3.2 The licensing process as a whole and key phases in accordance with the Finnish Nuclear Energy Act

Nuclear power projects progress in **phases (Figure 3-2)**. These phases form a whole in which each phase requires separate reports, official assessments, decisions and licenses before it is possible to move on to the next phase. The phases are described in more detail in Chapter 3.4 and Figure 3-3.

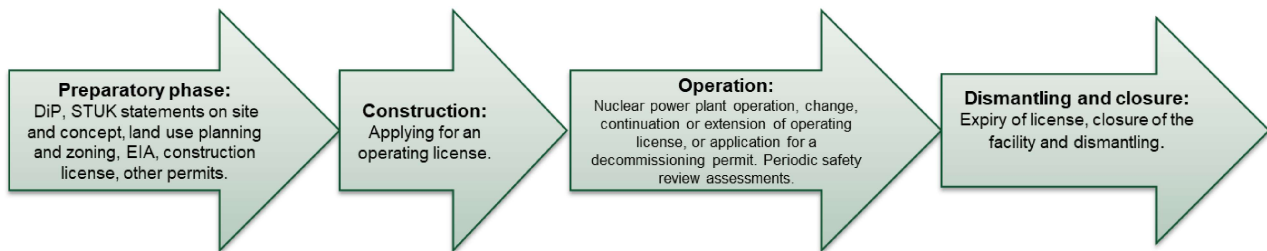


Figure 3-2. Main phases of a nuclear power plant's life cycle.

The table below presents the key terms related to the licensing process under the Nuclear Energy Act and their definitions.

Licensing, permitting (luvitus)	A general term for all official procedures related to applying for official permits for the construction, operation and decommissioning of a nuclear facility. The Ministry of Economic Affairs and Employment steers this process in Finland, and the Radiation and Nuclear Safety Authority (STUK) is responsible for the technical safety evaluation. Among other things, licensing includes the decision-in-principle (DiP), the construction license and the operating license phase.
Licensing (lisensointi)	In the Finnish language, this term refers to the technical evaluation and approval carried out by STUK. It focuses on whether the design and implementation of the facility meet the requirements for nuclear safety. This is part of the overall licensing process, but it focuses on safety technology.
Decision-in-principle (periaatepäätös)	A decision-in-principle (DiP) is a political decision made by the Finnish Government (large nuclear power plants >50 MW nominal heating capacity) or the Ministry of Economic Affairs and Employment (SMRs, <50 MW nominal heating capacity) on whether the nuclear power plant project contributes to the overall good of society. Under the new Nuclear Energy Act, a DiP is submitted to Parliament as a government report.
Construction license under the Nuclear Energy Act (Ydinenergilain mukainen rakentamislupa)	A construction license under the Nuclear Energy Act is a license to build a nuclear power plant granted by the Finnish Government after a decision-in-principle has been made. A construction license under the Construction Act is also required.
Operating license (käyttölupa)	An operating license means a license to operate a nuclear facility after its construction.
Decommissioning (käytöstäpoisto)	Cleaning and dismantling the radioactive parts of a nuclear power plant and the measures related to preparing for those procedures.
Site, siting (unofficially known as plant site) (sijaintipaikka)	The physical location where construction of the nuclear power plant is planned. Site approval is part of the construction license decision under the Nuclear Energy Act, and it involves an environmental impact assessment (EIA), a land use planning and zoning process guided by the Land Use Act, an examination of local conditions and interaction with stakeholders in the area. Without a site suitability evaluation, it is impossible to proceed to the construction license (Nuclear Energy Act).



Strategic environmental assessment (SEA) (SOVA-arviointi)	Assessment of the environmental impact of plans and programmes. The authority carries out an SEA as part of the decision-in-principle.
Environmental impact assessment (EIA) (YVA-arviointi)	The EIA procedure refers to a process under the Act on the Environmental Impact Assessment Procedure (252/2017) that identifies, assesses and describes the likely significant environmental impacts of a project before decision-making.
Transboundary environmental impact assessment (rajat ylittävä ympäristövaikutusten arviointi)	A transboundary environmental impact assessment based on the Espoo Convention (SopS 67/1997). The transboundary environmental impact assessment procedure applies to nuclear projects when they are likely to have significant impacts in other countries (sections 29a of the Act on the Environmental Impact Assessment Procedure, sections 311 and 314 of the Nuclear Energy Act). This is performed as part of the EIA procedure. The Espoo Convention also obliges authorities to consult and notify the authorities and citizens in other countries of these projects, and it is a good idea to allocate time for this during project preparation.

3.3 Key actors

License applicants and license holders are key actors in Finland, as they have overall responsibility for safety related to using nuclear energy. They are responsible for licensing applications, construction, operation, maintenance, decommissioning, nuclear waste management and the costs of nuclear waste management (waste management obligation).

Currently, license holders in Finland are Fortum, TVO and Posiva. In 2021, Posiva applied for a license for the final disposal of spent nuclear fuel in Olkiluoto. Outokumpu, for example, also holds a license for the use of nuclear materials in industry.

The table below lists key actors and stakeholders as well as their roles and responsibilities.

Actor	Role and responsibilities
Finnish Government (Valtioneuvosto)	Makes a decision-in-principle on large nuclear plant projects from the perspective of the overall good of society.
Ministry of Economic Affairs and Employment MEAE (Työ- ja elinkeinoministeriö TEM)	Responsible for the general steering of nuclear energy use and for energy policy guidelines. Prepares decisions-in-principle (small projects) and construction/operating licenses. Contact authority for EIA. Steers and supervises nuclear waste management.
Radiation and Nuclear Safety Authority STUK (Säteilyturvakeskus)	An independent safety authority that monitors radiation and nuclear safety. Evaluates the safety of the applicant and the facility, does not comment on energy policy. Under the new law, STUK is also the permit authority for nuclear technical facilities (interim storage for SMR plants and storage and processing facilities for low- and intermediate-level waste) and in certain other cases.
License applicant/holder (luvanhakija/ luvanhaltija)	A license applicant is an organisation that develops a nuclear power plant project and applies for a construction license, operating license and other permits related to building a nuclear power plant. According to the Nuclear Energy Act, the license applicant's organisation must already have sufficient expertise and financial prerequisites in the application stage. The license holder is obliged to comply with the construction or operating license and the regulations issued in it. The license holder is also responsible for nuclear waste management and its costs.
Technology supplier/Vendor (Teknologian toimittaja)	Delivers the reactor technology and is responsible for the design and technical implementation of the facility.



Operator (operaattori)	Responsible for the daily operation and safety of the facility. Often the same as the license holder but may also be a separate operator.
Supply chain (toimitusketju)	Delivers safety-critical components and services for facility construction and operation.
Technical Support Organisation (TSO)	Provides the license holder with expert support, e.g. in safety evaluations and planning. For example, VTT.
Finnish Supervisory Agency (LVV)	The Finnish Supervisory Agency grants environmental permits and water permits (as of 1 January 2026).
Other authorities (muut viranomaiset)	For example, Tukes (chemical safety permits) and rescue authorities participate in the permit processes and supervision.
Municipality (kunta)	Veto right concerning placement of a nuclear facility in its area. Responsible for land use planning and zoning and participates in decision-making.
Local energy company (paikallinen energiayhtiö)	Can be the owner, license holder, operator or heat/electricity purchaser.
Residents, landowners, associations, communities (asukkaat, maanomistajat, järjestöt, yhteisöt)	Participate in consultations, may affect the progress and acceptability of the project.

3.4 Early phases of nuclear power plant licensing

Licensing of a nuclear power plant in Finland begins with the phases that provide a framework for early decision-making in the project: the decision-in-principle, STUK statements on the facility concept and design bases for the site, construction license and operating license. Figure 3-3 summarises these early phases and their mutual progression and presents the general structure of the licensing process.

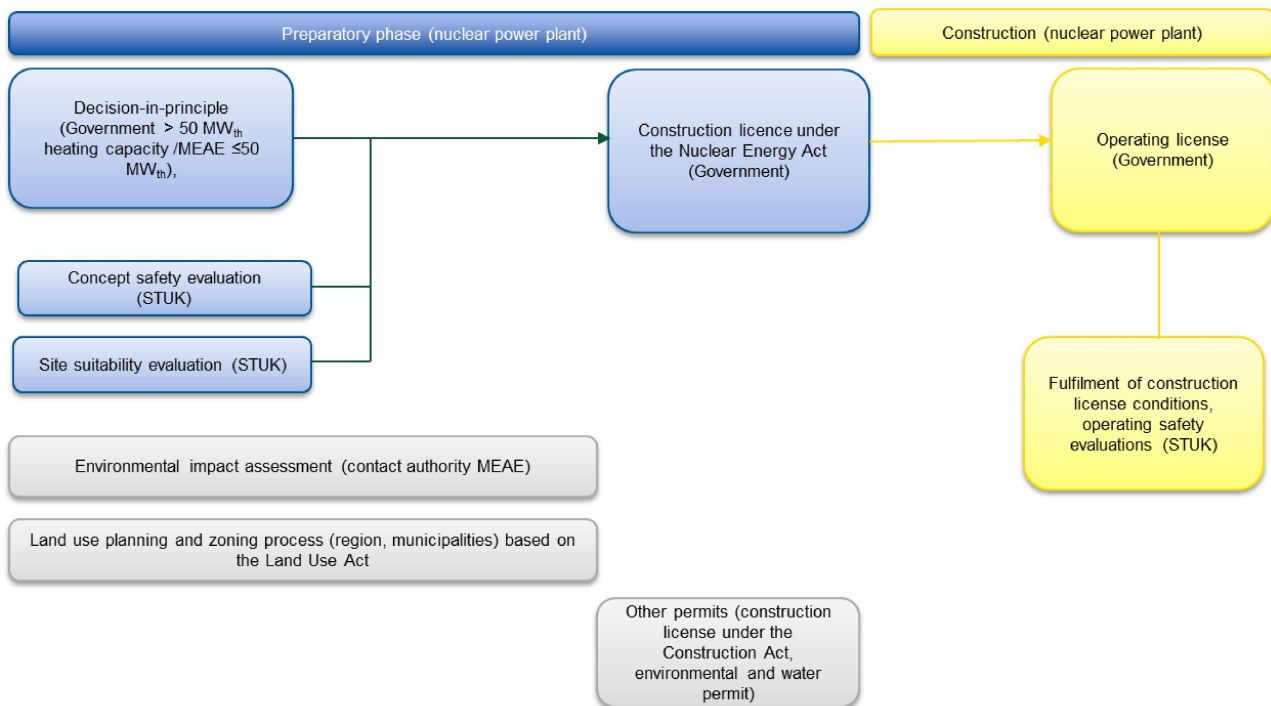


Figure 3-3. The nuclear power plant licensing process during the preparatory and construction phases of the project according to the draft of the Finnish Nuclear Energy Act. More detailed prerequisites for a decision-in-principle, construction license and operating license are presented in Chapter 29 (decision-in-principle on a nuclear power plant project) and Chapter 30 (licenses relating to a nuclear facility) of the Nuclear Energy Act and especially Section 300 (construction license) and Section 301 (operating license).

The **decision-in-principle (DiP) phase** evaluates whether the project contributes to the overall good of society. The Finnish Government makes decisions on larger nuclear power plants and SMRs with >50 MW nominal heating capacity while the Ministry of Employment and the Economy can make the decision for smaller SMRs (< 50 MW nominal heating capacity). In the future, the decision will be submitted to Parliament as a government report. In the DiP phase, the site of the nuclear power plant has not necessarily been determined yet, because a more extensive site suitability evaluation is only a prerequisite for a construction license under the Nuclear Energy Act. An EIA and other site-related reports are also needed for the site suitability evaluation. During the DiP phase, there may also be several potential sites for one type of nuclear facility. The statement that STUK issues as part of the DiP is not necessarily the actual safety evaluation, because the DiP application does not require the type of information on the facility or site needed to perform the actual safety evaluation.

STUK's statements on the nuclear power plant concept and site. STUK evaluates the safety of a nuclear facility on the basis of reports from the applicant's vendors and assesses whether the facility meets the requirements outlined in section 81 of the Nuclear Energy Act. The evaluation can be performed in a modular manner for one type of nuclear power plant, with consideration to site-specific requirements. In practice, this means a somewhat lighter evaluation in the future if the plant concept has already been evaluated. Similarly, STUK also issues a statement on the suitability of the site for a nuclear facility (Nuclear Energy Act, sections 67–70). These statements are key prerequisites for the progress of the project and for a construction license under the Nuclear Energy Act.

The conditions of the construction license are specified in Chapter 30 of the new Nuclear Energy Act (licenses for nuclear facilities). Among other things, the license applicant is responsible for investigating the size of the required precautionary action zone and other site-specific risks related



to the safety of the facility, such as earthquake and flood risks. In addition, an EIA must be prepared and the required plans compiled, for example, concerning nuclear safeguards and waste management for the entire life cycle of the facility (implementation plan for nuclear waste management and decommissioning). One of the prerequisites for a construction license is the municipality's consent, which in practice is given as part of the land use planning and zoning process or as a separate decision (the municipality's veto right). The license applicant is also responsible for applying for a construction license and other permits (water permit, environmental permit and chemical safety permit). The authorities (STUK, Finnish Supervisory Agency, Tukes) and the ministry evaluate fulfilment of the conditions.

The operating license phase involves evaluating whether the conditions for the construction license have been observed and whether it is safe to start operations at the facility.

It should be noted that a **facility for final disposal of nuclear waste** requires a separate license that is not included in the nuclear power plant permit. The organisation of waste management is discussed later in Chapter 3.11.

3.5 Selecting a nuclear facility site

Site selection for nuclear facilities in Finland is a multi-stage process based on the Nuclear Energy Act and the Radiation and Nuclear Safety Authority's regulations concerning matters such as emergency arrangements (STUK Y/2/2024) and site safety (draft 1/2026, previously YVL A.2).

According to international guidelines (IAEA 2015, 2019), site selection for a nuclear power plant includes the following areas:

- Definitions of site selection criteria according to the design bases, which can be used to completely discard certain areas (*exclusion criteria*), or which should be taken into account when selecting the site and determining the order of preference (*discretionary criteria*).
- In the *site survey stage*, large regions are investigated to identify areas and locations that meet the site selection criteria.
- The *site selection stage* consists of comparing the sites and ranking them in order of preference based on more detailed investigations and the actual site selection, during which the most suitable site is eventually selected.
- The *site characterisation stage* involves detailed site-specific investigations to ensure that the site meets the criteria for site selection (corresponds to the design bases).

In practice, the site selection process of an SMR planned for a specific municipality proceeds in the same way, but on a smaller scale, than for large nuclear facilities.

Among other things, the site selection and site selection criteria (*design bases*) for a nuclear power plant are influenced by:

- The size of the precautionary action zone, emergency arrangements and their feasibility based on the Nuclear Energy Act (Section 65) and the Radiation and Nuclear Safety Authority Regulation on the Emergency Arrangements of a Nuclear Power Plant (STUK Y/2/2024).
- Factors presented in the STUK regulation (draft 1/2026, previously YVL A.2):
 - Existing activities in the area that are significant for the society and which could be affected by an accident at a nuclear facility.
 - Local conditions affecting the characteristics of the site and its safety (for example, external events such as floods or earthquakes, accidents occurring near the site and human factors).
 - The nature of operations at the nuclear facility (nuclear energy production or nuclear waste management).



- Other nuclear facilities on the site and the potential impacts of their operations.
- The immediate surroundings of the site and its characteristics.
- The arrangement of safe operation and monitoring of the facility.
- **The extent and level of detail required for site investigations and surveys must be proportionate to the safety risks** associated with the nuclear facility and related activities. In practice, sufficient resources should be allocated for planning site investigations in order to ensure that the investigations are performed consistently and to the necessary extent. In addition to demonstrating safety, site investigations are needed to assess constructability and costs.
- In addition, investigation and evaluation of the site characteristics must be done in a systematic, comprehensive and traceable manner based on a quality plan or a sufficiently comprehensive management system.
- Environmental impacts of the nuclear power plant. The environmental impact assessment (EIA) is based on the Act on Environmental Impact Assessment Procedure. In addition, a strategic environmental assessment (SEA) of the environmental impact of plans and programmes is carried out as part of the decision-in-principle. Under the Espoo Convention (and its Protocol) countries that could be affected by the nuclear power project must also be consulted. The license holder should prepare for this international consultation by allocating sufficient time for it in the project schedule.
- Land use planning and zoning (see Chapter 3.6).
- Other permits to be considered (see Chapter 3.7).
- The purpose of the nuclear power plant (district heating/electricity or both) and the optimisation of its site, for example, in relation to the location of the district heating network.

The license applicant is responsible for the site selection process, defining the precautionary action zone and emergency planning zone, performing the environmental impact assessment (EIA) and other necessary investigations. However, nothing prevents the municipality from surveying potential suitable sites for the nuclear power plant in advance if the municipality has the desire to build nuclear power. When selecting a site, it is also a good idea to consider decommissioned power plants or industrial facilities in sites that could be suitable for construction of a nuclear power plant as such. Underground construction may affect the size of the precautionary action zone and the site of the facility, but in this case the safety of the nuclear power plant must also be demonstrated using appropriate calculations and analyses.

3.6 Land use planning and zoning and the municipality's veto right

Land use planning and zoning is an essential part of nuclear facility site approval and the entire licensing process in Finland. This procedure includes the regional land use plan (projects with regional significance), the component master plan and the local land use plan. Depending on factors that include the size of the precautionary action zone, SMRs may not always be of regional significance, but this is assessed on a case-by-case basis. The local land use plan makes it possible to obtain a construction license and presents the construction arrangements in the area. Land use planning and zoning ensures that the land use in the area is appropriate and compatible with the rest of the environment in terms of the nuclear facility. The EIA procedure produces reports that also serve land use planning and zoning.

For the purpose of the land use plan, the project developer or license applicant preparing the nuclear power plant submits a proposal for a precautionary action zone based on emission, disturbance and accident analyses (the new Nuclear Energy Act, section 300, prerequisites for granting a construction license). This means that in the future, STUK regulation Y/2/2024 will be applied to define the size of the precautionary action zone on a case-by-case basis for each nuclear power



plant site. In the land use planning and zoning process, STUK provides a statement and takes a position concerning the proposed precautionary action zone based on the available material.

In Finland, the municipality has a “**veto right**” for nuclear power plant projects, and the municipality may use a veto decision to prevent construction of a nuclear facility (nuclear power plant, final disposal repository) in its area. The land use plan must be approved before applying for a construction license under the Nuclear Energy Act.

3.7 Other permits and facility construction needed in Finland

Among other things, the nuclear facility project also requires a water permit (construction in water areas), an environmental permit (emissions and impacts of operations), which are both granted by the Finnish Supervisory Agency, and a chemical safety permit (storage and handling of hazardous chemicals, does not apply to radioactive substances), which is granted by Tukes.

Construction of the facility is governed by the Nuclear Energy Act and the Construction Act. When applying these two laws, section 96 of the new Nuclear Energy Act on clarifying their coordination during construction must be taken into account. The starting point for construction is to ensure that safety is not compromised at the nuclear facility.

3.8 Estimated total duration of licensing and land use planning and zoning

Finnish Energy (2021) has estimated based on the old Nuclear Energy Act that the licensing, land use planning and zoning would last a minimum of two years and a maximum of 7–8 years if all land use planning phases are appealed. In future, the duration of land use planning and zoning may be affected by whether the project is steered at the regional land use plan level. This, in turn, depends on the regional significance of the project.

Modular evaluation of the nuclear power plant concept required for a construction license may reduce the total duration of licensing if the same plant type is being considered for several locations.

3.9 Roles of different actors during the life cycle of a nuclear power plant

This chapter presents an example of the possible roles in Finland played by the municipality, energy company and authorities at different stages of the nuclear power plant life cycle. In this example, the license applicant is a local energy company owned by the municipality.



Phase	Energy company	Municipality	Authorities
1. Preliminary investigations and project development	Initiates the project, performs technical and financial investigations, surveys potential sites and the preliminary risks.	Participates in discussions, supports investigations from the perspective of land use planning and zoning and other infrastructure (such as district heating networks) and assesses the project's compatibility with the city's strategy.	Pre-evaluation of the project is already possible during the start-up phase (STUK).
2. Political will and decision-in-principle (DiP)	Prepares an application for a decision-in-principle for the state (MEAE), justifies the need for and benefits of the project.	Municipal support is a requirement for the construction license, but if the site has already been selected in the DiP phase, the municipality can already participate in political dialogue as part of the planning process.	MEAE, Finnish Government, Parliament (government report). STUK pre-evaluation, SEA
3. Environmental impact assessment (EIA procedure)	Is responsible for preparing the EIA report, organises consultations and notifies residents.	Participates in the EIA process by issuing statements, ensures opportunities for engagement	MEAE (EIA contact authority).
4. Land use planning and zoning	Makes an initiative for land use planning changes, submits reports and plans.	Responsible for the land use planning and zoning process (general and local land use plan), organises consultations and processes the plans. The regional council compiles the regional land use plan and it is approved by the regional assembly. In the future, the regional land use plan will specify the nuclear power plant sites that are of regional significance.	The municipality, regional council
5. Site selection and evaluation	Provides authorities and land use planning and zoning (e.g. STUK) with the necessary information on the site and estimates the adequate size of the precautionary action zone for land use planning and zoning purposes.	Ensures that the site is suitable for energy e.g. district heating production and the city's infrastructure.	STUK, the municipality, regional council
6. Facility concept evaluation	Presents the facility supplier and the technical solution to the authorities.	Can participate in the evaluation from the perspective of municipal energy production and urban structure.	STUK assesses the safety of the concept
7. Water permit, environmental permit, chemical safety permit	Prepares and applies for the required permits.	Issues statements in permit processes, ensures conditions that are acceptable to the city.	Finnish Supervisory Agency (water and environmental permit) Tukes (chemical safety permit)
8. Construction license (Nuclear Energy Act and Construction Act)	Applies for construction licenses, submits the required reports and documents.	Grants a construction license (Construction Act), supervises the prerequisites for construction locally.	MEAE, STUK (Nuclear Energy Act), the municipality (Construction Act)
9. Construction and commissioning	Responsible for construction, testing and commissioning.	Supervises construction and commissioning, ensures network readiness.	STUK, the municipality
10. Operation	Responsible for the operation and safety of the facility.	Monitors that operation complies with the conditions set by the city.	STUK (Nuclear Energy Act), the municipality
11. Decommissioning	Responsible for decommissioning of the facility	Monitors that operation complies with the conditions set by the city.	STUK, MEAE



3.10 Organisational models

The organisational models for SMRs are still under development in Finland and internationally. The various business models and operating models differ especially in terms of the following questions:

- Who is the **project developer and license applicant**? Possible actors are energy companies, industrial companies, consortiums, service companies. International actors may also have a major role as technology suppliers and partners?
- Who is the **license holder and who is the operator**, and can these be different organisations? In Finland, the license holder has a key role that cannot be outsourced
- Who is responsible for **maintenance** at different stages of the life cycle? In the different models, maintenance can be implemented as a separate activity or outsourced to service companies, but the license holder must ensure sufficient quality and monitoring of maintenance.
- How do **subcontractors and service companies** participate in the operations?

In Finland, the safe use of nuclear power is based on the license holder taking full responsibility for the safety of the facility, the quality of its operations and the management of nuclear materials and waste. This responsibility is strictly defined by law and cannot be transferred outside the sphere of the license holder.

The license holder is always responsible for nuclear waste management until the final disposal facility has been closed or the waste management obligation has been transferred to another operator. A transfer of the waste management obligation is appropriate in the different business models, especially if the organisation has limited ability to manage the waste.

The figure below presents **four possible alternatives (Figure 3-4)** that illustrate different ways of organising the ownership, operation and responsibilities related to SMRs based on the scenarios that were presented in our previous report (Keto et al. 2025) and the drafts of the new Nuclear Energy Act:

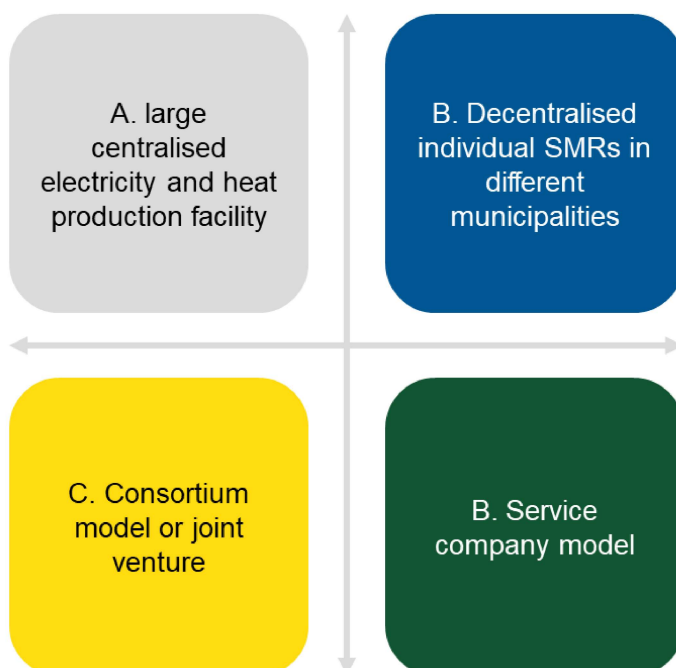


Figure 3-4. Potential organisational models.



Scenario A: A large centralised SMR for generating both electricity and heat

- One larger or several SMR units in a single large facility (e.g. 500 MW_e).
- The license holder is a large energy company that owns the SMR/SMRs.
- The license holder also operates the facility.
- A clear majority of company ownership is based in Finland and the European Economic Area (EEA).
- The license holder is responsible for waste management, through the company, or the waste management obligation is transferred to another party (Section 206).
- Suitable for electricity production and possibly also for district heating.
- One operator (the license holder) is responsible for permits, operation, maintenance, safety, etc.
- Corresponds to the model used in existing nuclear power plants.

Scenario B: Decentralised individual SMRs in different municipalities

- Individual SMRs located in different parts of Finland, mainly for district heating production.
- Each SMR facility has its own license holder.
- The operator can be a license holder or a separate company (e.g. an energy company to ensure expertise). However, the license holder also has legal responsibility for operation even if it has been purchased as a service.
- The owners of the companies (license holders) can be, for example, municipalities, national or municipal energy companies or local consortiums. A clear majority of company ownership is based in Finland and the EEA.
- The license holder has legal responsibility for permits and other activities related to the facility.
- The license holder is responsible for waste management, through the company, or the waste management obligation is transferred to another party (Section 206).
- Enables local energy production and ownership, but do the organisations have sufficient expertise and does a sufficiently stable financial basis exist for the activities?

Scenario C: Consortium model or joint venture

- Several SMR facilities located in different parts of Finland, the facilities have been designed to produce electricity, heat or both.
- The license holder is a single company for all the facilities.
- The operator can be a license holder or a separate company (e.g. an energy company to ensure expertise). However, the license holder also has legal responsibility for operation even if it has been purchased as a service.
- For example, the company (license holder) may be owned by several municipalities and companies that form a consortium or a joint venture that owns the SMR facilities. A clear majority of company ownership is based in Finland and the EEA.
- The license holder has legal responsibility for permits and other activities.
- The license holder is responsible for waste management, through the company, or the waste management obligation is transferred to another party (Section 206).
- Makes it possible to share risks and costs among several owners.
- Particularly suitable if individual municipalities do not have sufficient expertise or resources.

Scenario D: Service company model

- An external service company sells heat/electricity to a municipality or to industry as a service.
- The license holder is the service company.
- The operator is the service company.



- The municipality or industrial customer purchases energy under a service contract, but is not responsible for the operation or licenses/permits related to the facility.
- Enables the utilisation of SMR technology without local operational expertise.
- As the license holder, the service company is responsible for all operational and safety obligations.
- The service company (license holder) is responsible for waste management, through the company, or the waste management obligation is transferred to another party (Section 206).
- A clear majority of the service company's ownership is based in Finland and the EEA.

The role of municipalities varies in the different models. The greatest responsibility for the municipality/energy company owned by the municipality comes from the license holder role. The role is smaller if the municipality only serves as the owner, customer or as the site of the facility. **The organisational models in Finland are not fully established yet and may differ from those discussed in this chapter.**

3.11 Nuclear waste management in Finland

By law, all nuclear waste generated in Finland, including that generated by SMRs, must be disposed in Finland. Final disposal is needed to safely isolate the waste from people and from the environment.

After its use in a reactor, nuclear fuel becomes spent fuel, or **high-level waste (HLW)**. Spent fuel first requires cooling and interim storage, after which it will be ready for final disposal deep into the Finnish bedrock.

Nuclear power production generates also low- and intermediate-level waste (LILW) arising, for example, from plant operation and maintenance (protective clothing, equipment, decommissioning waste, etc.). Final disposal of LILW generated by existing power plants is usually placed in final disposal caverns in the facility area, while high-level waste is delivered to Posiva's final disposal repository in Olkiluoto.

- low- and intermediate-level waste arising, for example, from plant operation and maintenance (protective clothing, equipment, decommissioning waste, etc.)

The spent fuel and other radioactive waste generated by SMRs based on light water technology are essentially similar to the spent fuel of existing nuclear power plants. As a result, existing methods can be used to safely handle final disposal. The license holder for the SMR is responsible for managing the radioactive waste generated at the facility. When SMRs are located near an urban environment, it is important to be aware that radioactive waste will be at least temporarily stored on the site even if it would be transported to a centralised interim storage. All temporary or interim storages must be arranged so that they do not pose a hazard to the environment and people. New reactors – those not based on light water – can produce different types of spent fuel, and the final disposal solutions for these require international research and development. (Naumer et al. 2026)

The license holder in Finland is always responsible for arranging nuclear waste management and its costs, and a credible waste management plan must be presented already during the construction license phase. The license holder also pays a fee to the Finnish National Nuclear Waste Management Fund. A separate licensing process exists for the construction, operation and closure of a final disposal repository. The construction of a final disposal repository also requires municipal approval for construction and the land use plan.

Different alternatives for organising waste management have been identified (Naumer et al. 2026, see Figure 3-5 and 3-6):

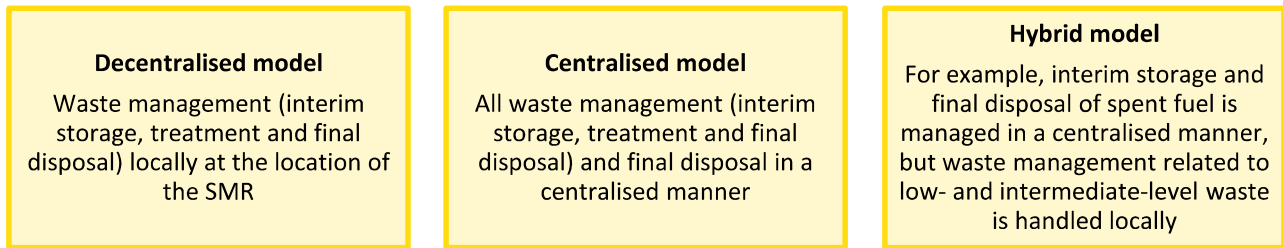


Figure 3-5. Various generic models for organising waste management.

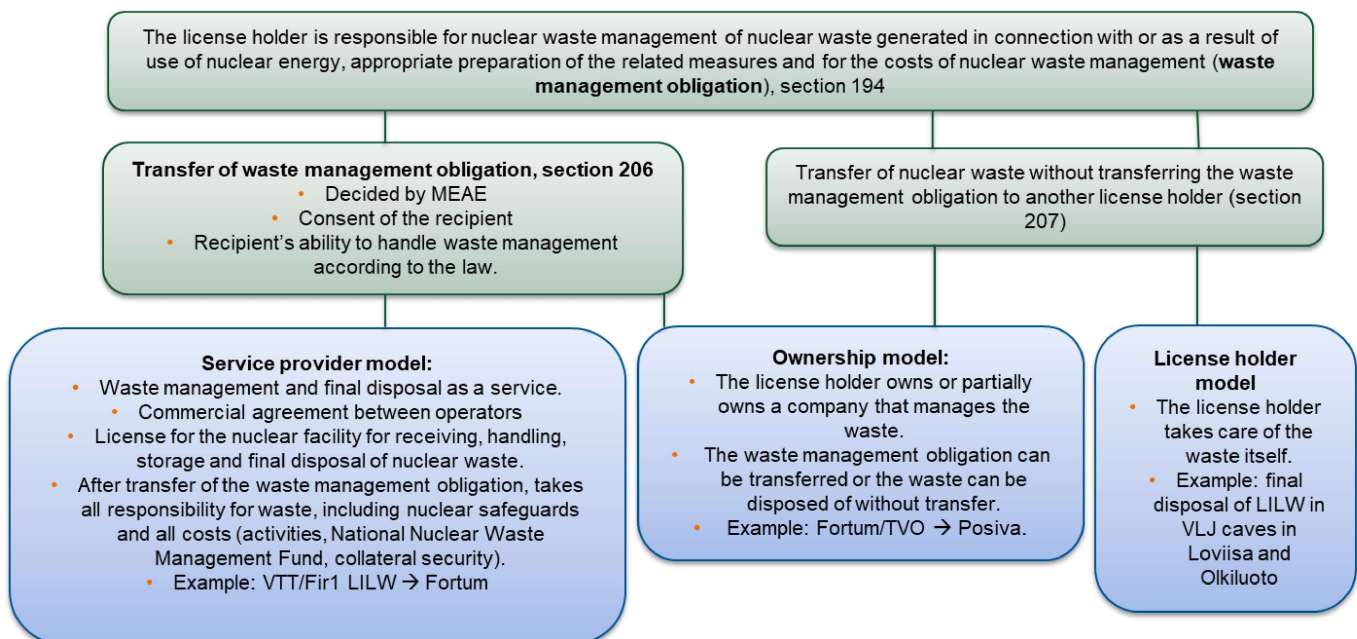


Figure 3-6. Various organisational models and the transfer of the waste management obligation.

The choice of model is influenced by factors such as the ownership base of the facilities, the expertise of the actors, financial resources and the arrangements permitted in the legislation. In the centralised model, it should be noted that SMR sites must have sufficient interim storage capacity for spent fuel (cooling pond size) so that the fuel can be cooled to a safe temperature for transport before being transferred to a centralised interim storage. The cooling time depends on the reactor type.

Further information:

- [Nuclear waste management - Ministry of Economic Affairs and Employment](#)
- [Ydinjätteen loppusijoitus | Radiation and Nuclear Safety Authority STUK](#) (Only in Finnish)
- [Posiva - Final disposal](#)
- [VTT_R_00076_22.pdf](#)
- [Edellytykset pienreaktorien turvalliselle käytölle: lupajärjestelmän ja valvonnan kehitysnäkymiä](#) (Only in Finnish)



4 Ensuring safety

As is the case internationally, the use of nuclear power is heavily regulated in Finland, with the aim of ensuring that, regardless of the type and size of the nuclear reactor, the use of nuclear power does not pose a danger to people and the environment in any situation. Finland is also bound by Euratom and international obligations related to safety of using nuclear energy and nuclear safeguards, which ensure that the use of nuclear energy does not contribute to the proliferation of nuclear weapons.

The production of electricity in nuclear power plants is based on radioactive decay of the uranium material in the fuel (fission reaction) inside the nuclear reactor. The fission reaction produces heat efficiently and heats the water in the reactor. The fission reaction occurring in the fuel is a self-sustaining chain reaction.

The most important task of nuclear safety monitoring is to ensure that the chain reaction remains under control in all situations (control of criticality), the residual heat is removed, and radioactive substances do not spread into the environment. Safety must also be ensured when handling and transporting nuclear fuel and in nuclear waste management.

The safety analysis report is a key set of documents describing the nuclear facility and its safety arrangements. "The safety analysis report describes the information required for assessing the safety of a nuclear facility, its systems, structures, equipment and site, and the demonstration of safety, and its objective is to ensure that a sufficient overall understanding of safety at the nuclear facility is maintained (Section 94, draft of the Nuclear Energy Act)".

Ensuring the safety of a nuclear facility is **risk-based** and, for example, SMRs designed to produce heat have safety advantages due to their lower power output, simpler systems and passive safety features. However, their location in urban areas involves certain challenges.

The table below explains the key terms related to nuclear safety:

Nuclear safety (<i>ydinturvallisuus</i>)	The most important principles of nuclear safety are safety, security and safeguards.
Safety (<i>turvallisuus</i>)	In this context, safety refers to ensuring the safety of a nuclear power plant in accordance with the defence-in-depth approach. This requires several independent functional and structural levels that ensure the safe operation of the plant, the prevention and management of accidents and mitigation of their consequences. These aim to prevent damage to the reactor and the harmful spread of radiation to the environment. For more information: Safety principles Radiation and Nuclear Safety Authority STUK
Security (<i>turvajärjestelyt</i>)	Security refers to measures that ensure the safe use of nuclear energy and radiation and prevent intentional damage. These measures are implemented in the nuclear facility and its area as well as in other functions where nuclear energy is used. They include administrative, technical and operational arrangements and information security . For more information: Nuclear security arrangements Radiation and Nuclear Safety Authority STUK
Safeguards (<i>ydinmateriaalin valvonta</i>)	The purpose of safeguards is to ensure that nuclear materials, nuclear facilities and technology in the field are used peacefully in accordance with licenses, notifications and international treaties. For more information: https://stuk.fi/en/nuclear-materials
Radiation safety (<i>säteilyturvallisuus</i>)	Radiation safety refers to all principles, design solutions and measures that ensure the protection of employees, the population and the environment from the harmful effects of ionising radiation in the normal nuclear plant operations and in the event of deviations and accidents. Ensuring radiation safety is based on the optimisation of radiation exposure, compliance with exposure limits, and



	structural and functional radiation protection solutions that are applied in the design, construction, operation and work planning of a nuclear facility. Radiation protection for the residents near the site includes an assessment of the sufficiency of the precautionary action zone and the emergency arrangements at the nuclear power plant STUK-Y-2/2024. For more information: Nuclear materials Radiation and Nuclear Safety Authority STUK
Safety culture <i>(turvallisuuskulttuuri)</i>	Safety culture refers to the shared values, attitudes and ways of working in an organisation that ensure safety is given overriding priority in decision-making and operations. It is reflected in the actions of both management and personnel at all levels. It includes technical systems and procedures as well as communication, learning and the underlying assumptions that guide behaviour.

4.1 STUK supervises the safety of nuclear energy production

SMRs are part of the same licensing and control system as large reactors. STUK evaluates safety and issues a statement on it in all phases of the licensing process (EIA, decision-in-principle, construction license, operating license, decommissioning license). A positive evaluation by STUK is a requirement for receiving a license. STUK also participates in the site evaluation in conjunction with the environmental impact assessment and land use planning and zoning.

Safety oversight is continuous:

- STUK inspects and monitors the safety of the facility during construction, operation and decommissioning.
- This includes technical solutions and the expertise and functional capacity of the license holder’s organisation.
- STUK monitors radioactive substances and radiation in the facility environment by means of a measurement network and laboratory studies. For more information: [Radiation today](#)

The prerequisites for building an SMR near a residential area are:

- The radiation limits set in the legislation are not exceeded in any situations.
- In the event of an accident, protective measures (e.g. evacuation) can be taken if necessary.
- Each case is evaluated separately and the applicant must demonstrate that the safety requirements are met.

Further information:

- [Front page | Radiation and Nuclear Safety Authority STUK](#)

4.2 Nuclear safeguards

Nuclear safeguards in Finland are based on international treaties. In nuclear power plants, nuclear safeguards apply to fresh nuclear fuel, spent fuel (high-level waste) and other radioactive waste generated during operation (low- and intermediate-level waste). STUK, IAEA and EC are responsible for nuclear safeguards in Finland. Among other things, this includes nuclear material accounting (e.g. material, quantity, location), reporting and inspecting the operator’s own safeguard arrangements. A more detailed description of nuclear safeguards is available in the Nuclear Energy Act and on the STUK website.



4.3 Emergency planning and preparedness for a radiation emergency

Emergency planning refers to the preparedness of a nuclear facility for accidents and other events that threaten safety and the measures required to manage the situation and to prevent or limit the harmful effects of radiation. A nuclear facility must have emergency arrangements and an emergency plan that are approved by STUK and which are kept up to date (Section 172). The emergency plan describes, for example, the emergency response organisation, measures, facilities, equipment, communication systems, alarm systems, training as well as exercises (Section 172). In addition, the emergency arrangements must be coordinated with the rescue and preparedness plans of the authorities (Section 170).

The table below describes the key terms related to emergency planning and preparedness for a radiation emergency.

Emergency situation (<i>valmiustilanne</i>)	An accident or event during which the nuclear power plant's safety has deteriorated or is in danger of deteriorating or requires enhanced preparedness to act in order to ensure plant safety.
Precautionary action zone (<i>suojavyöhyke</i>)	The precautionary action zone of a nuclear facility must be defined in such a way that, in the event of an accident, there is a high probability that there will be no need to evacuate the population outside the precautionary action zone in order to prevent or limit the immediate and severe effects of radiation. It must be possible to effectively carry out evacuation within the precautionary action zone.
Emergency planning zone (<i>varautumisalue</i>)	The emergency planning zone of a nuclear facility must be defined in such a way that, in the event of an accident, there is a high probability that there will be no need to take urgent protective measures outside the zone to limit the delayed effects of radiation on the health of the population. An example of a measure inside the emergency planning zone could be sheltering indoors in case of an accident. An external rescue plan must be drawn up for the emergency planning area. The precautionary action zone is part of the emergency planning zone.

In Finland, **emergency planning** for nuclear power plants is based on the Nuclear Energy Act and Government decrees. STUK ensures that the facilities have up-to-date emergency arrangements covering technical, organisational and communication capabilities for different exceptional situations. STUK inspects the emergency arrangements, instructions and training on a regular basis.

Emergency exercises and planning involve close cooperation with the central government, regional administration, rescue departments, the police, municipalities and energy companies. In addition, cooperation between different authorities, cities and residents as well as the awareness and preparedness of residents is particularly important in an urban area.

Communication in a radiation emergency is one of the core functions of emergency planning:

- The emergency plan and operating instructions specify how a warning is issued and operating instructions are issued to the public in a quick and understandable manner.
- Communication systems and alarm systems are part of emergency arrangements.
- The obligation to communicate applies to both personnel inside the facility and the surrounding population.

Emergency planning for SMRs must also take into account the fact that the transport of nuclear material and emergency exercises in the urban environment require special attention and close cooperation with the rescue department and, if necessary, also with neighbouring municipalities.

**Sources and additional information:**

- [Regulatory guide on preparedness \(VAL\) | Radiation and Nuclear Safety Authority STUK](#)

5 Social acceptability

Construction of new nuclear power plants requires social acceptability of the project and the fact that stakeholders, such as the municipality where a facility is located and local residents, mostly support the project and feel that they can, for example, trust the parties preparing the project, the authorities and feel confident that the facility is safe. On a general level, **there is a high level of support for energy production with nuclear power in Finland**. According to the latest survey conducted by Finnish Energy, up to 68% of Finns have a positive attitude and only 9% have a negative attitude towards nuclear power. The survey also revealed that 29% of Finns are very positive, 40% fairly positive, 13% fairly negative and 4% very negative about the deployment of an SMR. The use of nuclear power was widely accepted as a means of combating climate change ([Finnish Energy 2025](#)).

Site selection for nuclear facilities may cause local concerns or even resistance. When considering an SMR for heat and/or electricity production, it is therefore important for the early planning phase to include different approaches that take societal issues and perspectives into account and encourage residents and various local communities to participate in the process. As is generally the case with any plans related to implementing the energy transition, SMR projects also need to address questions of fairness (see Vainio & Kojo 2024) and social acceptance.

This chapter provides a general overview of how residents can influence and participate in nuclear power plant projects. This is followed by a review of the results from a resident survey on SMR carried out by LUT University in the Helsinki metropolitan area and Tampere in 2022. The survey focused on residents' attitudes related to the deployment and location of SMRs, and examined statements on perceived safety, trust, public engagement and communication, and nuclear waste management. The resident survey data was collected in November and December 2022 when energy prices were high due to Russia's invasion of Ukraine, which may partly explain the support for SMRs.

5.1 How residents can exert influence and participate

Residents can officially **influence** the progress of a nuclear power project, especially during **land use planning and zoning and the EIA procedure**. Ways of exerting influence:

- Written opinions and memos while land use plans are available for public inspection
- Participation in public events and discussion events
- Sending questions and feedback to a municipality, ELY Centre or project coordinator
- Right to appeal approved plans and possible licenses to the Administrative Court

Land use planning and zoning process in Finland

The land use planning and zoning process (for the local land use plan) and how residents can take part in the process are presented in Figure 5-1. Initiation of a land use plan must be announced in accordance with section 108 of the Municipalities Act. According to the draft of the new Land Use Act, information on **land use planning and pending land use plans will be provided in the municipal public information network in the future**, and planning reviews will be discontinued. Correspondingly, information on regional land use plans that are pending or will be initiated in the near future will be displayed in the public information network of the regional council.



In addition, interested parties (landowners or persons in the area whose housing, work or other conditions are affected or likely to be affected by the land use plan, as well as the authority and organisation whose field of activity is covered in the planning) must be informed so that the parties can obtain information on the starting points, planned schedule and the engagement and assessment procedure related to land use planning and zoning.

The authority preparing the land use plan must also prepare a **plan for the engagement and interaction procedure and assessment of the impacts of the land use plan**.

Depending on the land use plan, **it is approved** by either the municipal council (local land use plan) or the regional council (regional land use plan). In the future, the master plan and local land use plan could also be prepared simultaneously and approved with the same decision.

Note! The up-to-date Land Use Act must be checked for a more detailed description of the land use planning and zoning process.

Notification of initiating a land use plan	Compiling the preparation material for a land use plan	Preparation material for the land use plan available for public inspection	Approval of the land use plan
The municipality draws up an engagement and assessment plan and informs the residents and interested parties about initiation of the plan.	The municipality compiles the material used to prepare the land use plan, which specifies the possible site of the nuclear power plant.	Residents and interested parties can familiarise themselves with the preparation material for the land use plan and present their opinions.	The municipal council approves the land use plan. The decision can be appealed to the Administrative Court.

Figure 5-1. Opportunities for residents to exert influence during the land use planning and zoning process (local land use plan) in Finland.

Sources and additional information:

- [Alueidenkäytön lainsäädännön uudistus - Ministry of the Environment](#) (Only in Finnish)
- Lausuntopalvelu. Luonnos hallituksen esitykseksi eduskunnalle uudeksi alueidenkäyttölainsiksi. Lausuntopyynnön diaarinumero VN/26856/2023 (Only in Finnish)
- [Lausunto - Lausuntopalvelu](#) (Only in Finnish)

The concept of social licence

In the vicinity of cities and residential areas, building social licence requires new and more extensive efforts from both the city and project developers, license applicants and license holders. In these environments, acceptability cannot be built only through traditional, one-way communication - although clear and up-to-date information continues to be important. Open, multi-directional and multi-channel dialogue methods are also needed to address the benefits of nuclear power, the associated risks and the practices used to ensure safety in all conditions.

Residents must have a clear understanding of how they can present their views, the opportunities they have to exert influence in different phases of the project and how the authorities, the applicant and the license holder work to promote their safety. This involves specific challenges in cities: multilingualism, multiculturalism and diversity of resident groups affect who is reached and how engagement is realised. This is why interaction and communication must be accessible, multilingual and culturally sensitive in order to ensure that all resident groups are heard in a genuine manner.

In addition, it is particularly important that people living near the facility understand how it affects their everyday life and what is expected of them in exceptional and accident situations, such as



radiation emergencies. Attention must also be paid to the transport of nuclear materials and waste, which can cause concern in an urban environment. Ensuring safety and transparency in this matter is essential to building social licence.

Sources and additional information:

- [Alueidenkäytön lainsäädännön uudistus - Ministry of the Environment](#) (Only in Finnish)

5.2 Finnish resident survey on SMR

5.2.1 Introduction

Common energy production solutions are socially important decisions, which is why it is important to survey citizens' attitudes towards them. This is particularly relevant in the case of nuclear power, as citizens have very different opinions concerning the location of nuclear power plants and nuclear waste facilities. When considering placement of an SMR near a residential area, it is therefore important for the early planning phase to include different approaches that take societal issues and perspectives into account and encourage residents and various local communities to participate in the process. As is generally the case with any plans related to implementing the energy transition, SMR projects also need to address questions of fairness (see Vainio & Kojo 2024) and social acceptance.

A resident survey on small-scale nuclear power was carried out by LUT University in the Helsinki metropolitan area and Tampere in 2022. Residents' attitudes related to the deployment and location of SMRs were examined, along with statements on perceived safety, trust, public engagement and communication, and nuclear waste management.

The surveys demonstrate how attitudes towards small-scale nuclear power differ between different age groups, genders and political affiliation. Men are more positive about SMRs than women. The results illustrate how important it is to consider differences among citizens when communicating about small-scale nuclear power and in the involvement of citizens.

5.2.2 Resident survey data

A total of 2,104 Finnish-speaking residents aged 18–75 responded to the survey on SMRs in Helsinki (n=793), Espoo (n=474), Vantaa (n=332) and Tampere (n=505) in November–December 2022. The data was collected by Innolink Oy as a web-based survey for a consumer panel, and the margin of error was 2.1%. Of the respondents, 46.9% were men and 51.4% were women, 1% were of other genders, and 1.1% did not want to indicate their gender. The age and gender distribution of the respondents to the survey corresponded to that of the population in the area, although respondents aged 60–69 were over-represented and the youngest groups (under age 30) were slightly under-represented in the data. The respondents were more likely to be higher educated and in the highest income brackets, while low-income groups (under EUR 20,000 per year) were clearly under-represented.

This resident survey commissioned by LUT University examined the respondents' attitudes towards the introduction of SMRs in Finland and in the respondent's municipality of residence. The survey also addressed issues related to nuclear waste management, safety and the location of SMRs, as well as residents' trust in key actors in the nuclear power sector. Residents also expressed their opinions on different themes related to SMR projects, such as the decision-making process in nuclear power policy and issues related to public engagement and communication.



5.2.3 Attitudes towards the introduction of SMRs

Attitudes towards SMRs have mainly been positive in Finland. The Finnish Energy Attitudes report published by Finnish Energy (Finnish Energy, 2025) shows that Finns’ positive attitude towards nuclear energy has increased and awareness of SMRs has expanded in recent years. This is also reflected in a resident survey mapping attitudes towards SMRs, according to which 64% of residents in the Helsinki metropolitan area and Tampere were positive about the introduction of SMRs in Finland. Of the respondents, 12% had a negative attitude and 24% were neutral. When asked “*What is your attitude towards the introduction of an SMR in your municipality of residence?*” (see Table A), the negative attitude towards placement of an SMR increased slightly in each respondent municipality compared to an SMR being deployed in Finland.

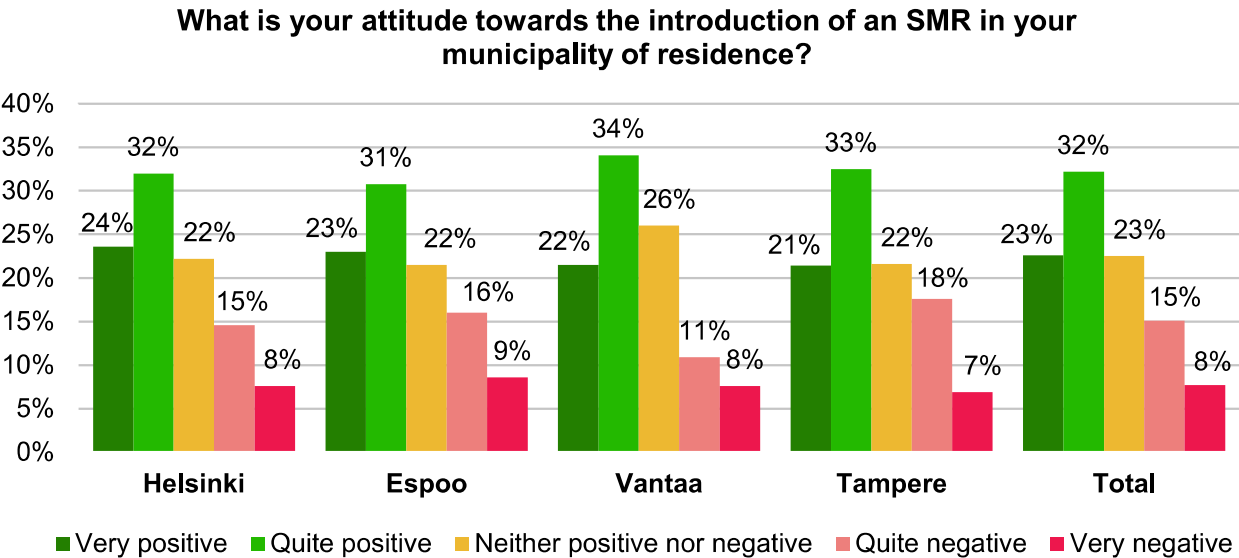


Table A. *What is your attitude towards the introduction of an SMR in your municipality of residence? Responses among residents of Helsinki, Espoo, Vantaa and Tampere (n=2,103).*

The responses of residents in the metropolitan area (Helsinki, Espoo and Vantaa) and Tampere were similar: the majority of residents (54–56%) were very positive or quite positive about an SMR being located in their municipality of residence. On the other hand, there were minor differences in the relationship between neutral and negative respondents by municipality. For example, one quarter (25%) of respondents in Tampere were negative. Significant differences between the respondent groups can be seen when the acceptability of introducing SMRs is examined, for example, according to the background of the respondents. For example, there are noticeable differences in the attitudes of men and women concerning SMRs (Kiviluoma et al. 2025).

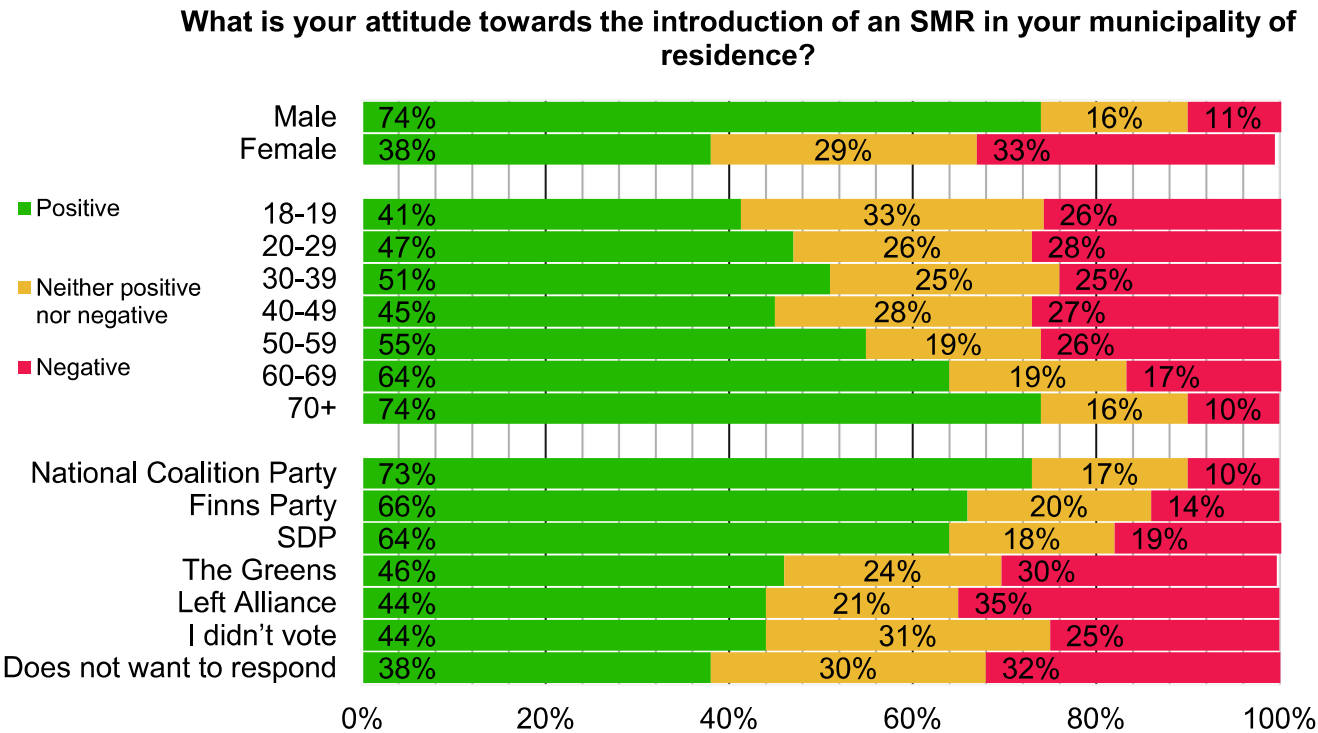


Table B. Attitude towards the introduction of an SMR in the municipality of residence, presented according to the respondent's gender, age group and political affiliation.

The introduction of an SMR in the respondent's municipality of residence is most accepted among men, the oldest age groups (over the age of 60) and people who voted for the National Coalition Party. Women, the youngest (under 29) age groups and people who voted for the Left Alliance are on average more negative about the placement of an SMR in their municipality of residence (see Table B). It has been demonstrated that differences in education level or the amount of information available about SMRs do not account for the major differences in acceptance among men and women (see Kiviluoma et al. 2025). Instead, this is a societal phenomenon affected by many factors. Differences in the attitudes of men and women towards nuclear power have been visible for a long time in Finnish statistics (for example, see Finnish Energy) and also in Sweden and its decision-making related to nuclear power policy (Sundström & McCright, 2016).

A previous study on Finns' attitudes towards SMRs (Kojo et al. 2023) has also shown that the approval of small-scale nuclear power is not a direct indication of how close to their own home the respondent would be willing to have an SMR site. When asked about the desired distance between an SMR and their home (see Table C.), about one third (~30%) would accept an SMR more than 10 km from their home, and approximately 14% of the respondents would not accept its placement anywhere near their home. At the same time, approximately 40% of the residents would accept an SMR located less than five kilometres from their homes – but only 14% would accept an SMR located less than one kilometre from their home.



How close to your home would you accept an SMR site?

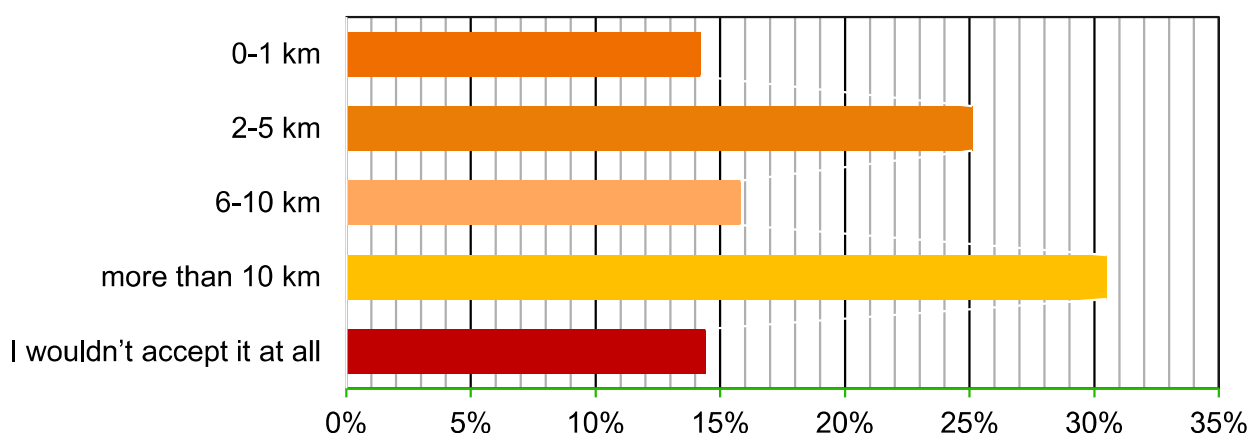


Table C. How close to your home would you accept an SMR site? Responses of residents in the Helsinki metropolitan area and Tampere in kilometres (n= 2,100).

What is your attitude towards placement of the following power plants in your municipality of residence?

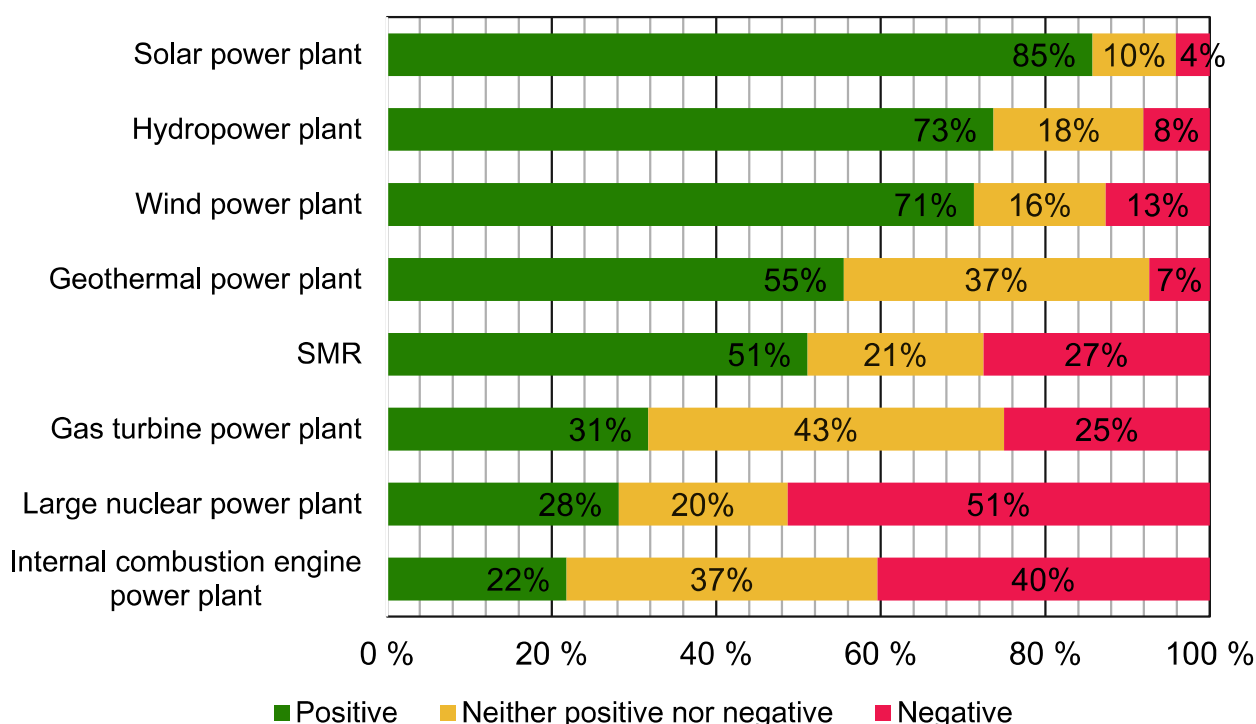


Table D. What is your attitude towards placement of the following power plants in your municipality of residence? Responses of residents in the Helsinki metropolitan area and Tampere in the 2022 resident survey (n= 2,082–2,096).

When comparing different types of electricity and heat generation plants, it is apparent (see Table D) that respondents were more positive about the placement of SMRs in the municipality of residence than, for example, placement of a large nuclear power plant. Approximately half of the residents (51%) had a positive attitude towards SMRs, while only just under one third (28%) had a positive attitude towards a large nuclear power plant. Renewable energy sources, such as solar



power plants, wind power plants, and hydropower plants clearly had the most positive reception among residents of the Helsinki metropolitan area and Tampere with more than 70% support. Only an internal combustion engine power plant (22%) received less support than a large nuclear power plant (28%).

5.2.4 Perceived safety

Almost half (44%) of all residents in the Helsinki metropolitan area and Tampere felt that SMRs were safe and less than a quarter (22%) considered them unsafe. One third (33%) of the respondents were unable to respond or were neutral about statements concerning the safety of SMRs. When perceived safety is examined according to the respondent's gender, it becomes apparent that 60% of men considered SMRs safe, while only 31% of women felt the same way. In total, 29% of women considered SMRs unsafe, while 14% of men felt that they were unsafe. In other words, the perceived safety of small nuclear power plants is seen differently in different respondent groups. Perceived safety is also influenced by, for example, global political events. When residents were asked whether their sense of nuclear safety has deteriorated since Russia's military invasion of Ukraine, 40% of the respondents estimated that their sense of safety had deteriorated. One third (33%) of the respondents were unable to respond or were neutral, and one quarter (26%) felt that this did not affect their sense of nuclear safety.

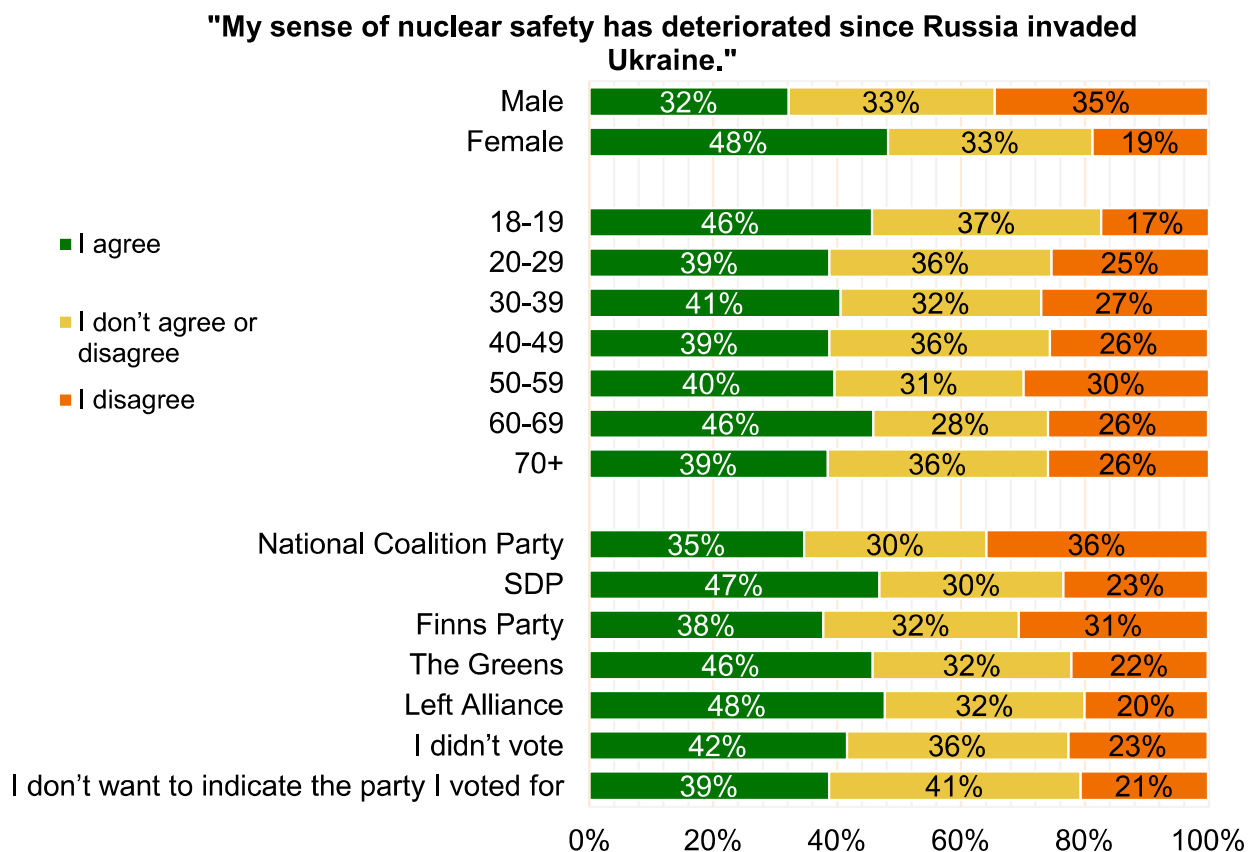


Table E. Responses of residents in the Helsinki metropolitan area and Tampere to the statement "My sense of nuclear safety has deteriorated since Russia attacked Ukraine", according to the respondent's gender, age and political affiliation (n=2,088).

With regard to the invasion of Ukraine and the subsequent change in perceived nuclear safety (see Table E), it should be noted that although almost half of women (48%) have experienced a deterioration in perceived safety, one third (32%) of men also felt the same way. Although many



respondent groups were unable to assess the impact on perceived safety or felt that the impact was neutral, the data shows that, for example, respondents who voted for the Finnish Social Democratic Party, the Greens and the Left Alliance experienced a deterioration in safety more often than those who voted for the Finns Party or National Coalition Party.

5.2.5 Trust in key actors

Residents of Helsinki, Espoo, Vantaa and Tampere were asked to assess trust in various nuclear sector actors, institutions and other stakeholders who are likely to participate in decision-making concerning SMRs in Finland in some way.

To what extent do you trust the following actors with regard to preparation and decision-making related to SMRs?

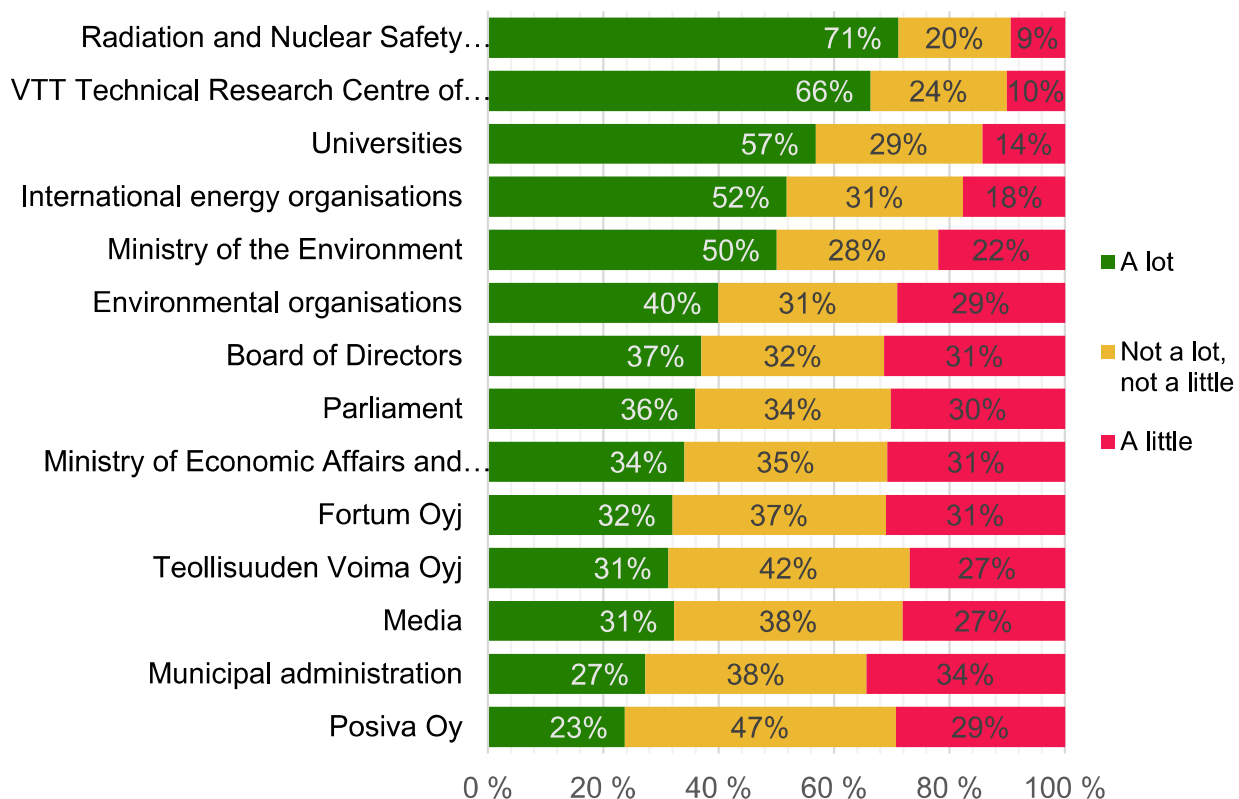


Table F. Responses of residents in the Helsinki metropolitan area and Tampere to the statement: To what extent do you trust the following actors with regard to preparation and decision-making related to SMRs? (n=2,090–2,100)

Residents in the Helsinki metropolitan area and Tampere assessed the Radiation and Nuclear Safety Authority (STUK) to be the most trusted actor with 71% support. VTT (66%), universities (57%) and international energy industry organisations (52%) were also among the most trusted actors. In terms of political institutions, it was interesting to note that although the Ministry of the Environment (50%) had a lot of trust, the Government (37%) had a lot of trust and Parliament (36%) had a lot of trust ranked in the middle of the comparison, municipal administration (34%) had the lowest level of trust. Municipal administration was the second least trusted actor, and although Posiva Oy had the lowest level of trust (23%), nearly half of the responses concerning Posiva Oy were neutral or uncertain about their position (47%). As a rule, the result corresponded to the previously reported assessment of trust in operators (Kojo et al. 2022a). Of the local operators, Tampereen Sähkölaitos Oy received a mostly neutral reception (45%) and had 27% support among Tampere residents. In the Helsinki



metropolitan area, Vantaan Energia Oy (42%) and Helen Oy (39%) received mostly neutral responses, although one third of respondents in the Helsinki metropolitan area expressed trust and mistrust in both (31% for and 30% against Helen, 30% for and 27% against Vantaan Energia).

Trust in key actors throughout Finland has also been measured in the Finnish Energy Attitudes survey carried out by Finnish Energy (Finnish Energy 2025, page 43, only in Finnish). This report shows that people have the greatest trust in STUK, energy research institutes, the Ministry of the Environment, the Energy Authority and the Ministry of Economic Affairs and Employment.

5.2.6 Public engagement and communication

The resident survey also mapped the key operating methods in decision-making, public engagement and communication related to small-scale nuclear power that should be followed when implementing or preparing any SMR projects. The residents who participated in the survey clearly supported participatory approaches and joint planning, which should be taken into account when planning SMRs.

If an SMR is planned for my municipality of residence...

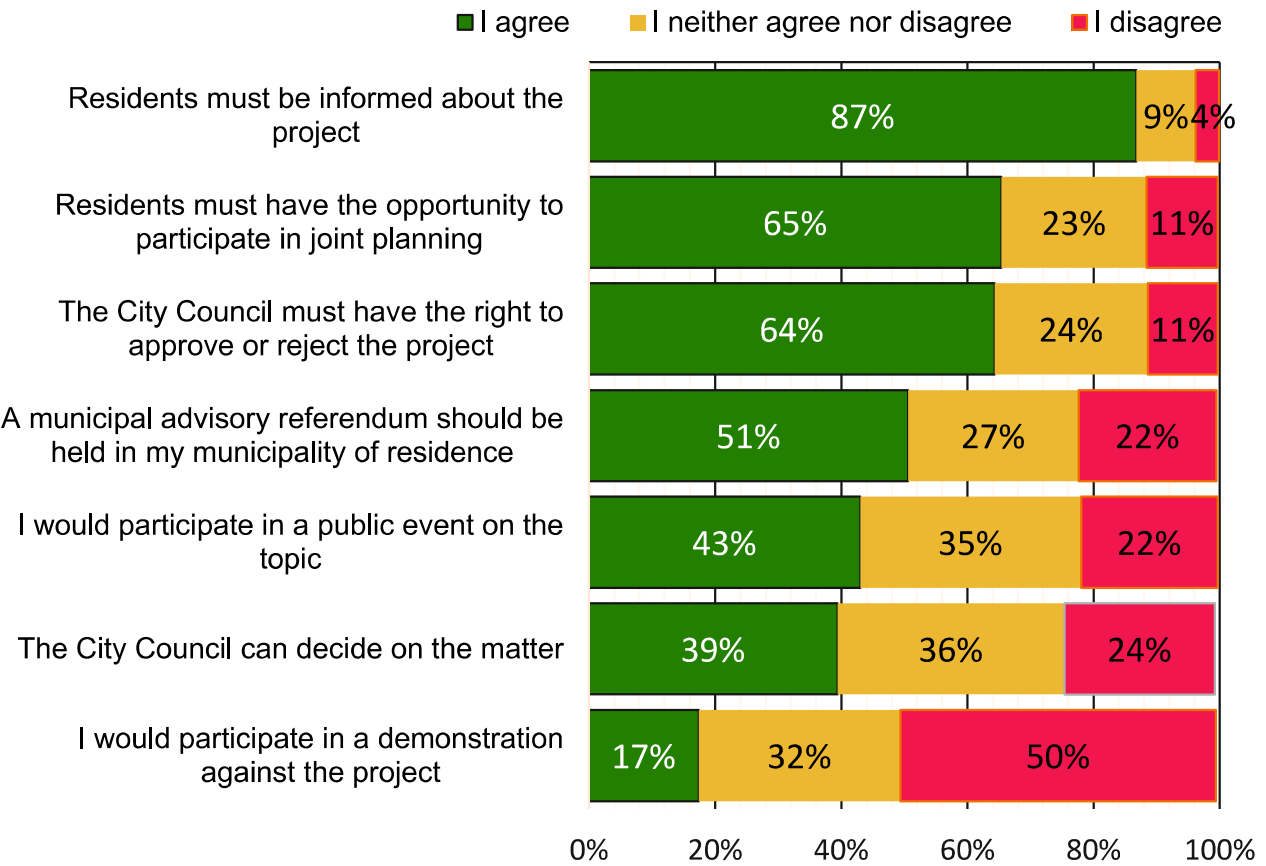


Table G. “If an SMR is planned for my municipality of residence...” The opinions of residents in the Helsinki metropolitan area and Tampere concerning statements related to public engagement and communication in the 2022 resident survey (n=2,084–2,100).

Informing residents (87%), the possibility to participate in joint planning (65%) and the city council's right to approve or reject the project (64%) emerged as the most important means of public engagement and communication for residents. Half of the respondents (51%) were also in favour of



a municipal advisory referendum, and 43% would participate in a public event on the topic. Although 39% were in favour of fully transferring decision-making power to the city council, residents' opinions were also divided on this issue: a quarter (24%) opposed decision-making by the city council and 36% of the respondents were neutral. Participation in a demonstration was the least interesting option for residents, as half of the respondents stated that they would not take part in a demonstration against the project.

5.2.7 Nuclear waste management

With regard to questions related to waste management at SMRs, the resident survey mapped the opinions of residents concerning the organisation of nuclear waste management at SMRs. The resident survey also examined the opinions of residents in the Helsinki metropolitan area and Tampere concerning the national principles for nuclear waste management.

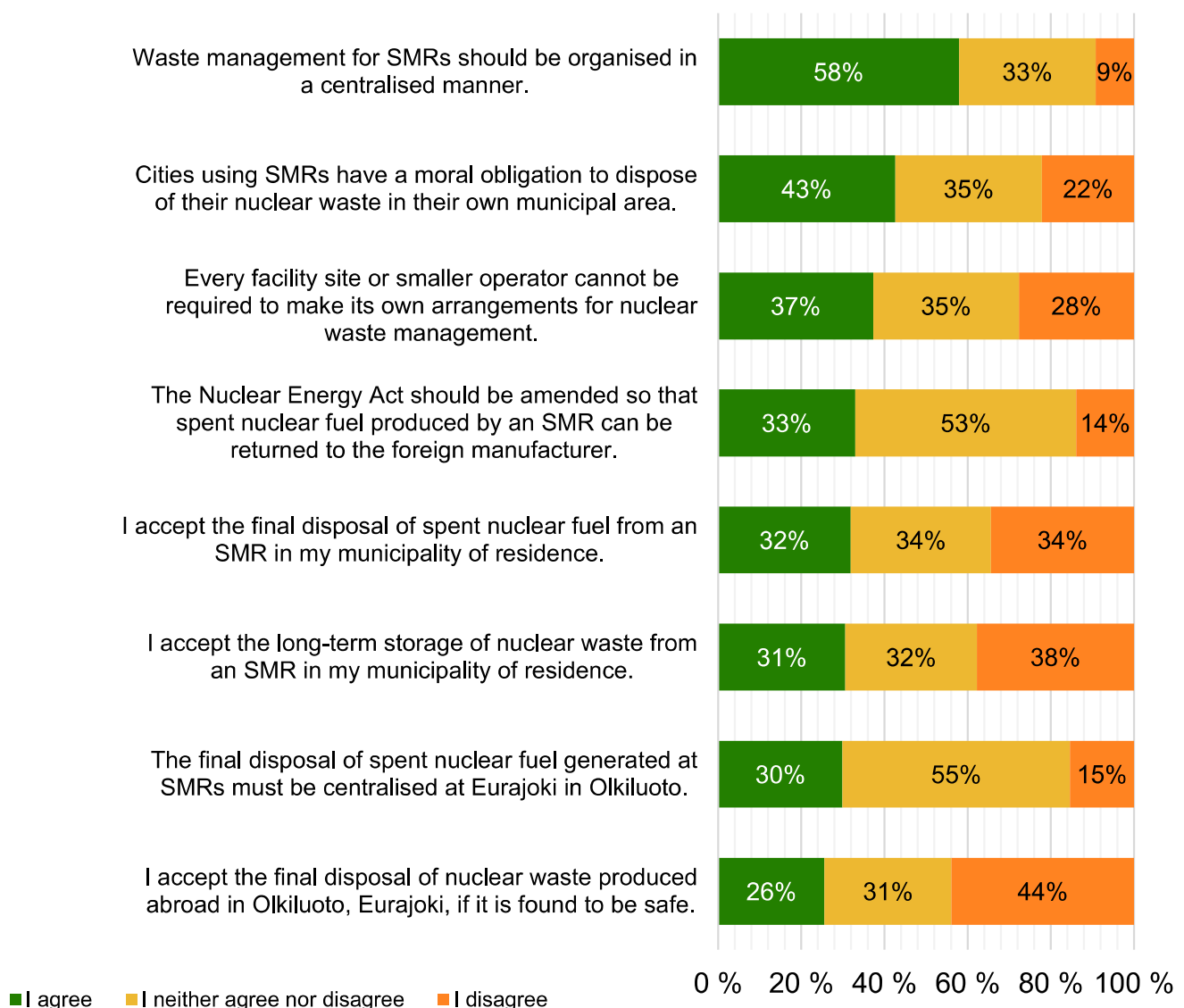


Table H. The opinions of residents in the Helsinki metropolitan area and Tampere concerning statements related to nuclear waste management in the 2022 resident survey (n=2,104).



According to previous studies (Kojo et al. 2022b; Kojo et al. 2024), residents’ interest in centralised nuclear waste management stood out with 58% support. The moral obligation of cities to organise the final disposal of nuclear waste in their own municipality was also mentioned by 43% of the respondents, although one third would not accept the final disposal of spent nuclear fuel (34%) or the long-term storage of nuclear waste (38%) in their own municipality of residence. Centralisation of the final disposal of nuclear waste at Olkiluoto in Eurajoki was a neutral option for half (55%) of the respondents, but 44% were opposed to the final disposal of nuclear waste produced abroad, even if it was found to be safe. Sending nuclear waste produced in Finland abroad was a neutral option for half of the respondents (53%) while one third (33%) of residents would be prepared to amend the Nuclear Energy Act in order to allow the return of nuclear fuel used by SMRs in Finland to the foreign manufacturer.

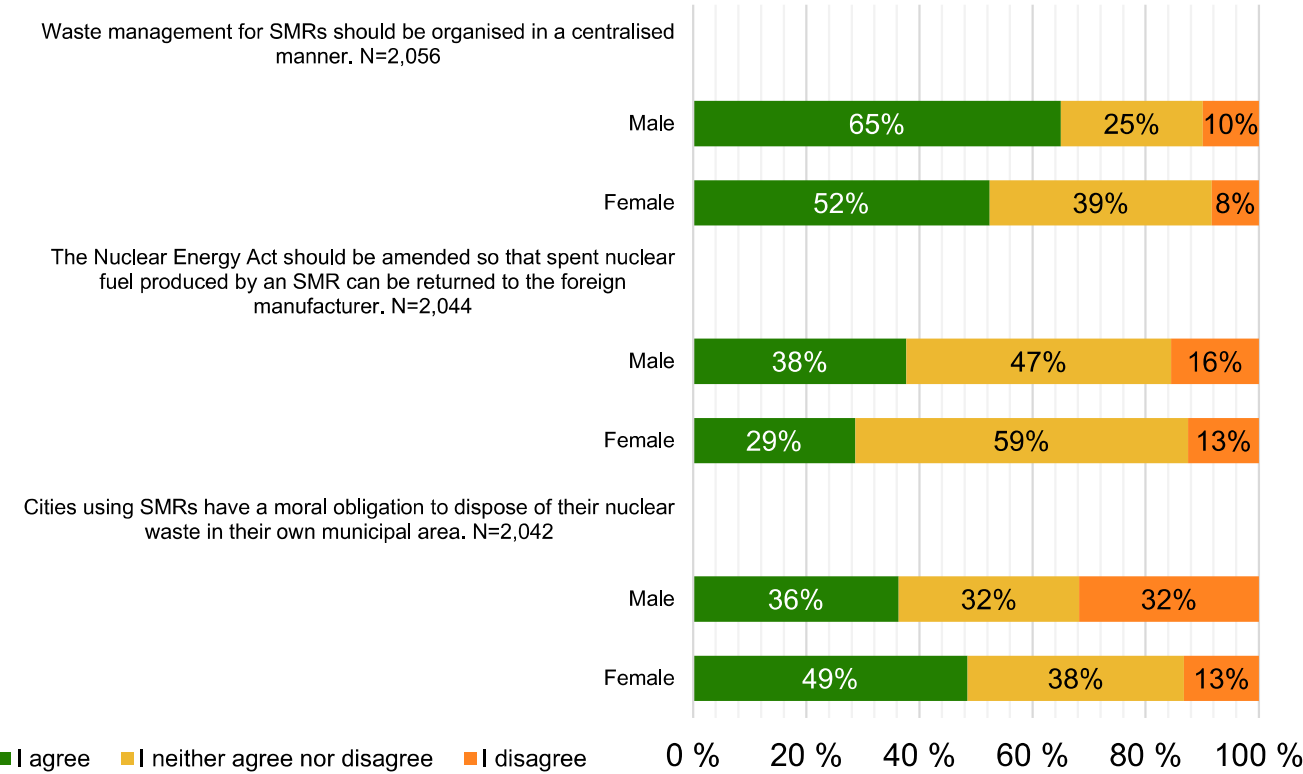


Table 1. The opinions of residents in the Helsinki metropolitan area and Tampere (n=2,104) concerning statements related to nuclear waste management in the resident survey, divided into male and female respondent groups.

Minor differences between men and women can be observed when examining the principle of centralising nuclear waste management or the statements concerning the moral obligation to dispose of nuclear waste within the boundaries of the respondent’s municipality of residence. Men are more in favour of centralised nuclear waste management for SMRs (men 65% vs. women 52%), while approximately half of women (49%) feel that the cities using small-scale nuclear power have a moral obligation to dispose of the nuclear waste they produce in the municipality. One third of men (36%) agree with the moral obligation statement, while one third (32%) disagreed with the statement. Amending the Nuclear Energy Act to allow the return of nuclear fuel from SMRs to the foreign manufacturer is primarily a neutral option for women (59%), and about half of men (47%) also have a neutral attitude towards the statement. However, it can be observed that men are more in favour of a legislative amendment than women (38% vs. 29%).



6 Impacts of SMR projects for municipalities

An SMR project may have various long-term and short-term impacts for a municipality or city. From the perspective of the municipality, these impacts are linked to the following factors: (Häkkinen et al. 2023, Valtavirta et al. 2023, European Parliamentary Research Service 2024, Deloitte 2025):

- Access to energy (electricity/heat) for municipal and/or industrial needs.
- Ensuring the availability of energy in crisis situations.
- Self-sufficiency of municipal and Finnish energy production.
- Achieving carbon neutrality targets.
- The employment situation in the municipality with regard to construction of the facility and operation of the completed facility, the entire supply chain and other necessary services.
- Income received by the municipality, for example through taxation or sale/lease of a plot of land.
- Risk assessments (safety in crisis situations).
- Land use planning and zoning and use of areas (see Chapter 3). In addition to the precautionary action zone, the impacts on other required infrastructure (roads, electricity networks and district heating networks) must also be taken into account.

The environmental impacts of an SMR are discussed in the Finnish Energy report (Finnish Energy 2021). Among other things, the environmental impacts of an SMR are related to water use if the plant is associated with the impacts of related to water if the plant uses water for cooling, exceptional and accident situations (precautionary action zone and other safety-related requirements) and radioactive waste. In addition, the plant may have an effect on more ordinary environmental impacts, such as the landscape, traffic, noise, etc.

7 Conclusions

Small-scale nuclear power for production of district heating and electricity has been planned in Finland in several locations, such as in Helsinki, Kuopio and Kerava, to replace energy production based on combustion. In addition, Fortum has examined the need for additional nuclear power in Finland, and small-scale nuclear power is one of the options that was studied. Most municipalities have not previously investigated the use of nuclear power, and the topic may be unfamiliar to decision-makers and municipal land use planners. The purpose of this guide is to serve as a short introduction to the topic in order to support municipal decision-making and facilitate the initiation and implementation of projects in the future.

The licensing of nuclear power plants is governed in Finland by the Nuclear Energy Act while land use planning and zoning is governed by the Land Use Act. Both laws have been updated and will enter into force at a later time (approximately 2027). The content of this guide is based on drafts of these acts, and this is why it is essential to always check the latest laws, regulations and instructions from the up-to-date legislation and the contact authorities.

Licensing of SMR plants in Finland is a multi-phase process. Prior to starting the actual licensing process for the project, the project developer may, if desired, carry out a preliminary study for which it can request a short advance evaluation from the Radiation and Nuclear Safety Authority (STUK) concerning the technology used. A Government decision-in-principle is required for nuclear power plants with a power output > 50 MW (nominal heating capacity). The decision-in-principle for facilities smaller than this can be made by the Ministry of Economic Affairs and Employment. The aim of the



decision-in-principle (DiP) is to assess the necessity, credibility and safety of the project, taking into account the overall good of society. The site of the nuclear power plant may not be known at this time or there may be several alternatives for it. Unlike in the past, an EIA is no longer required for a DiP, and this is only a prerequisite for a nuclear power plant construction license. Other reports and STUK statements on the facility concept and site are also required for a construction license. The facility must also have the other required permits (water permit, environmental permit, construction permit under the Construction Act and chemical safety permit) before construction can begin. In addition, an operating license is required for commissioning of a nuclear power plant. Among other things, this includes compliance with the terms of the construction license. Licenses for renewal of the operating license and dismantling of the facility will also be required at a later time.

Site selection for an SMR is a process designed to ensure safety during normal operation of the facility and in the event of disruptions and accidents. Site selection for an SMR typically proceeds in three phases. The first phase involves defining the selection criteria (design bases) in order to identify several potential site options that can be ranked in order of preference based on more detailed investigations. The most important criteria for site selection are based on the precautionary action zone and emergency planning zone specified for the facility. These can be used to determine if the site is suitable for the nuclear facility and how large an area is needed for the facility. Site selection is also influenced by site-related characteristics and technical and economic factors that include, for example, the location of electricity and district heating networks and routes suitable for transporting fresh and spent nuclear fuel. Municipalities should also consider old fossil energy production facility sites and industrial areas that may be suitable for small-scale nuclear power production as such. In addition, underground construction can be a good solution for an SMR. Once a site has been selected, further investigations are performed at the site to ensure its safety and compliance with the design bases.

The actual land use planning and zoning process can be started in parallel with licensing and site selection already during the DiP phase, or only later during the construction license phase. Whether the facility should also be defined in the regional land use plan depends on the impact the project has at the regional level. Local land use plans are approved by the municipality. The municipality also has the so-called “veto right” concerning nuclear facilities. A properly timed land use planning and zoning process is a prerequisite for the smooth progression of a project. The land use plan should not be confirmed too early if the necessary investigations related to the facility's precautionary action zone and emergency planning zone and other analyses related to facility safety (e.g. earthquake risk assessment) have not been completed.

The organisational models for SMR projects are not established yet and there may be several potential options. The license applicant and license holder have the most significant role in nuclear power plant projects. The owners may be a municipality, a municipal or national energy company or another actor in the European Economic Area. The facility supplier sells the reactor technology and likely also participates in the construction and deployment of the reactor and provides support during operation. In terms of project credibility and implementation, it is essential for the applicant (and the operator) to have sufficient nuclear energy expertise, a good safety culture and the financial prerequisites to complete the project – both in the short and the long term.

According to law, final disposal of nuclear waste produced in Finland takes place in Finland (except for research reactors). The license holder (the actor that produces the waste) is responsible for the arrangement and costs of nuclear waste management, including the actual costs, the financial provision paid into the National Nuclear Waste Fund and the collateral security (waste management obligation). This ensures that waste can be managed in all circumstances. The implementation plan for nuclear waste management and decommissioning is a prerequisite for a construction license. However, the license holder may delegate the waste management obligation to another party, who then assumes responsibility for the storage, final disposal and the costs of the activities. This requires a decision by the Ministry of Economic Affairs and Employment, licenses and commercial



agreements between the operators. If the nuclear waste cannot be disposed of in existing final disposal facilities for one reason or another, new waste management solutions have to be developed.

Nuclear waste includes high level spent nuclear fuel and low- and intermediate-level waste arising during operation and dismantling of the facility. The interim storage and transport of spent nuclear fuel requires sufficient space at the facility for the period needed for cooling of the fuel. In the centralised (and hybrid) solution, the fuel is then transferred to the centralised storage to wait for final disposal deep into the bedrock. Low- and intermediate-level waste can either be disposed of on the site (local solution) or it can also be transferred to a centralised storage facility. As local final disposal of spent fuel would require a great deal of studies, expertise and possibly the development of new final disposal concepts, a centralised solution can be considered more justified at this time. The deep borehole final disposal concept that is currently in the early stages of development could be considered in a local or centralised solution sometime in the future, provided that studies can ensure the long-term safety of the solution and its implementation can be demonstrated in such a reliable manner that the concept would meet all the licensing-related requirements.

Nuclear safety is the most important prerequisite for operating an SMR. This involves several different concepts, including ensuring the safety of the nuclear facility in accordance with the defence-in-depth principle, security, safeguards, ensuring radiation safety (precautionary action zones, emergency arrangements) and a good safety culture. In Finland, STUK serves as the safety inspector and supervisor for a nuclear power plant in accordance with the Nuclear Energy Act, the Nuclear Energy Decree, the Radiation Act, STUK regulations and guidelines as well as international treaties. The supervision covers technical solutions, the monitoring of radiation and radioactive emissions and assessment of the organisation's expertise and functional capacity. Emergency planning refers to a nuclear facility's preparedness for accidents and other safety-related incidents. The emergency arrangements are coordinated with the rescue and preparedness plans of the authorities. Municipal rescue departments have an important role in this process.

Support for nuclear power is generally high in Finland, which provides a favourable starting point for the progress of SMR projects. However, attitudes and opinions are not evenly divided and, for example, attitudes are more positive among men, people over the age of 60 and supporters of the National Coalition Party, while they become more critical among women and when the facility is located close to a person's own home. Attitudes towards nuclear waste management are slightly less positive, possibly due to the relatively low level of knowledge among citizens. When planning SMR projects, it is important for key actors to present and justify their options related to arranging nuclear waste management already in the early stages of the planning process. According to the survey, centralised nuclear waste management was considered the best solution.

SMRs cannot be built without the municipality's approval of the site or open, transparent and continuous dialogue with residents, interested parties and other stakeholders affected by the project. This is called social acceptability and social licence, which includes a much wider concept than communication or statutory hearings.

Consultations with stakeholders, interested parties and residents are part of the land use planning and zoning and EIA processes, but it is important to provide residents with regularly updated situational information, diverse opportunities for engagement and low-threshold events to express their opinions as the project progresses. **This is particularly emphasised in an urban environment, because the population is multilingual and multicultural and includes very different population groups with varying information needs and methods of participation.** Surveys and traditional public events often only reach part of the population – for example, mainly Finnish-speaking residents who are informed and participate actively. This may lead to a situation in which the project has not identified the concerns, information needs or barriers to engagement in



different population groups, which in turn decreases social acceptability and the sense of safety at later stages.

Finally, it must be stated that the construction of small nuclear power has many positive impacts for municipalities in the short and long term. Small nuclear power is one solution for the production of carbon-neutral energy, and it can significantly increase energy self-sufficiency in municipalities. This can also improve the operating prerequisites for other industries in the municipality. In addition, the project can create more permanent jobs in the municipality, which will remain throughout the life cycle of the facility. In particular, the construction period can also boost other sectors in the municipality through services and supply chains.



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