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From Promises to Practice: Finnish Cities as Testbeds for Just Small Modular Reactor Implementation

Matti Kojo [1], Markku Lehtonen [2,3], Anni Vainio [4], and Tapio Litmanen [3]

[1] Department of Social Sciences, LUT University, Finland
[2] Department of Economics and Business, Pompeu Fabra University, Spain
[3] Department of Social Sciences and Philosophy, University of Jyväskylä, Finland
[4] Department of Social Sciences, University of Helsinki, Finland

Correspondence: Matti Kojo (matti.kojo@lut.fi)

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Abstract

Small modular reactors (SMRs) have been proposed as a way to decarbonise urban district heating. To be technically and economically viable, SMRs should be located close to existing district heating networks and thus near residents. This would likely raise questions about fairness of, for example, the distribution of risks and benefits, and the opportunities to participate in SMR site selection. This article examines the role of energy justice in the construction of the technoscientific promise of SMRs. Such a construction process entails institutionalisation of the promise in, for example, policies, legislation, regulation, and funding decisions, and its materialisation in R&D, prototype, and commercial projects. The article analyses how energy justice considerations are used in either building or undermining the two key pillars of a technoscientific promise—its legitimacy and credibility. To be considered legitimate, a promise must address a widely recognised and urgent societal problem, whereas for credibility, it must be perceived as viable in practice. The processes whereby legitimacy and credibility are constructed and deconstructed, to foster or undermine the institutionalisation and materialisation of the promise, have significant implications for justice and equity across time, space, and groups of society. Building on earlier research on just energy transitions, the SMR promises in Finnish cities are analysed from three analytically distinct yet overlapping perspectives: distributive, recognition, and procedural justice. The material consists of documents and news items on R&D, policymaking, and municipal SMR initiatives.

Keywords

energy justice; legitimacy; nuclear energy; small modular reactors; technoscientific promises

1. Introduction

Enthusiasm for the supposedly new technoscientific promise of the nuclear sector, the small modular reactors (SMRs), has in recent years been spreading across the world. This is true also in Finland, albeit under the term "small nuclear power," instead of SMR. Climate change, energy security, energy independence, and the past problems with the construction of large nuclear reactors have been presented as key arguments for SMR technology. Industry spokespersons and politicians have been the most vocal in calling for measures to facilitate the construction of SMRs in Finland (Kari et al., 2023).

Both worldwide and in Finland, SMRs still remain a promise rather than a reality: The first Western-country SMRs are not expected to be operational until the end of the 2020s, whereas not only the commercial viability but also the true modularity of the only currently operating two SMRs (in Russia and China) is questionable. Although the materialisation of the promise of SMRs in commercial projects is at an early stage, its institutionalisation in policy, regulatory, and R&D frameworks as well as in networking among stakeholders and advocates has also in Finland been underway for several years (Kojo et al., 2023). Such institutionalisation has included support for SMRs in election campaigns, party programmes, the programme of the current Conservative government (Finnish Government, 2023), and in its climate and energy strategy. SMR research has been integrated into both private and public R&D programmes, in pursuit of the development of supportive "SMR ecosystems" (Häkkinen et al., 2023). Among the main objectives of the comprehensive reform of the Nuclear Energy Act, approved by Parliament in June 2026, was to facilitate the construction of SMRs by modifying nuclear safety regulation. A research project led by the Technical Research Centre of Finland (VTT) explored the options for managing waste from the possible future SMRs (Keto et al., 2025, pp. 11–13).

In Finland, SMRs have been primarily envisaged for decarbonising district heating in major cities. At the core of such plans has been the development of a low-temperature district heating reactor (LDR-50) concept, underway since 2020 at VTT. The startup company Steady Energy, a spin-off from VTT, continues to develop the LDR-50 concept towards commercialisation. The first preliminary agreements between municipal energy companies and technology developers were signed in 2023 and 2024.

If the SMR promise is to materialise in the form of commercial projects, it must be seen as legitimate and credible, not only internationally and nationally, but above all in the foreseen host communities. The processes whereby local-level legitimacy and credibility are built include political deliberations among local decision-makers, as well as regulatory procedures such as environmental impact assessment (EIA), zoning, and licensing. The true litmus test for the SMR promise is at the local level, where the criteria for legitimacy and credibility are likely to differ from those at the national and international levels (Lehtonen et al., 2026).

This article explores the role of energy justice in the construction of the SMR promise in Finland, examining the extent to which justice-related considerations have been used to either build or undermine the legitimacy of the SMR promise at the local level. To do so, the article draws on a typology of distributive, recognition, and procedural dimensions of energy justice in the SMR initiatives in the largest Finnish cities. Nine of the 10 most populous cities began to explore the SMR option in 2017–2023, mostly via initiatives launched by city councillors. Since then, the city administrations have responded to the initiatives.

We categorised the cities into three groups based on how city administrations have responded to SMR initiatives. In the "pioneer" cities (Helsinki and Kuopio), the municipal energy company has proposed alternative plant sites, an EIA procedure is being prepared, and the cities have signed preliminary agreements with potential technology suppliers. The "early followers" consist of cities (Oulu, Tampere) that are considering the possibility of including an SMR in their land use planning, for example. The "cautious majority" comprises the remaining five cities (Espoo, Lahti, Pori, Turku, Vantaa), which have declared they would monitor technological development and possibly reconsider the matter in the 2030s.

No Finnish city has made an investment decision on the construction of an SMR. Smaller cities, outside the scope of this study, such as Lappeenranta and Rauma, have suspended their earlier SMR plans, considering the investment costs excessive.

In the next section, we examine the energy justice challenges specific to the construction of the SMR promise. Section 3 outlines the context of the SMR promise-construction in Finland. Section 4 describes the data and methods, while Section 5 presents the results, structured according to the aforementioned city groups. The conclusion highlights key energy justice challenges at the early stages of SMR development.

2. The Technoscientific Promise of SMRs and Energy Justice

Earlier research has demonstrated the importance of promises for the development and deployment of technoscientific innovations (Joly, 2010; Parandian et al., 2012). To gain the necessary support from key stakeholders and policy actors—investors, politicians, industries, and ultimately the citizens at large—the technology needs to convincingly demonstrate its expected added value to society. Technoscientific promises are collectively constructed over time, through confrontation between promissory narratives and counter-narratives, and through the interaction between discourse, institutions, and material artefacts. Promises are performative and not "mere talk": The very aim of promising is to render possible what otherwise would be impossible, and to turn promises into self-fulfilling prophesies.

To be performative, that is, to become embedded in institutions (e.g., policies, laws and regulation, and funding decisions) and materiality (e.g., funding flows and R&D, prototype, or commercial projects), a technoscientific promise needs legitimacy and credibility (Joly, 2010). *Legitimacy* typically builds on the presumed ability of the technology or innovation to address a societal problem, objective, or aspiration that is widely recognised as crucial and urgent. *Credibility*, in turn, resembles "believability": The promise must be seen as a viable and realisable way of addressing the problem that underpins its legitimacy. Credibility usually relies on earlier experience and track record of the industry in question or on appeal to authority—authoritative voices that proclaim the feasibility of the technology.

Legitimacy, the focus of this article, relies in the energy sector typically on objectives relating to climate change, energy security, regional socioeconomic development, or the country's technological leadership. However, it has wider foundations: Most notably, a promise must demonstrate that the solution reduces or at least does not aggravate existing social injustices. For example, climate policies must be effective in reducing GHG emissions but also ensure fair distribution of costs, spatially (among countries and regions), temporally (across generations), and across sociodemographic groups.

The promise of SMRs presents particular justice challenges because of the lack of empirical evidence, given that the technologies are still untested and unproven. However, many justice issues identified in earlier research on conventional nuclear power are likely to apply also to SMRs (e.g., Cotton, 2021; Höffken & Ramana, 2024; Shove & Walker, 2014; Taebi & Roeser, 2015). Given that many energy injustices stem from the characteristics of the entire energy system, energy justice literature at large can offer useful lessons for the analysis of SMRs. In the following, we will illustrate and analyse energy justice in the SMR promise-construction by relying on the oft-used triptych of distributive, recognition, and procedural justice.

Justice challenges specific to nuclear power include the risk of unlikely but potentially catastrophic accidents, uncertain potential long-term impacts of low-dose radiation, nuclear weapons proliferation, and the various environmental, health, and social risks and impacts throughout the production chain, from uranium mining to reactor decommissioning and radioactive waste management (Cotton, 2021; Höffken & Ramana, 2024; Taebi & Roeser, 2015). Major challenges relate to the distribution of the benefits from the use and production of nuclear energy between groups of society, across time and space, whether such benefits be socioeconomic (e.g., job creation, access to electricity, tax revenues, competence-building) or environmental (e.g., climate change mitigation, reduced local pollution, biodiversity protection; e.g., McCauley, 2025; Muth et al., 2021, pp. 47–49; Ritchie, 2022). Problems of procedural justice include the technocratic and expert-led policymaking that tends to overlook citizen views in energy and nuclear policies and plant siting (Sovacool et al., 2019).

Earlier literature has identified also other dimensions, most notably restorative and cosmopolitan justice, which relate, respectively, to the temporal and spatial aspects of justice. In this article, we include these dimensions within our three-pronged framework. Restorative and cosmopolitan justice indeed illustrate the mutual interconnectedness of distributive, procedural, and recognition justice. Restorative justice relates to how existing or past injustices are rectified. Lyytimäki et al. (2023) evoke the closely related notion of anticipatory justice, denoting the ways of preventing injustices and considering future generations in planning and decision-making. Energy justice issues associated with technoscientific promises are by definition anticipatory, addressing questions such as how the benefits and burdens of energy production are shared among different groups of society both within and between generations, whose interests and values are to be recognised, through which processes justice is to be delivered, how the injustices that might nevertheless occur would be restored, and how equity between the regions and population groups across the world could be maximised.

Cosmopolitan justice highlights the spatial dimension of justice. Although the direct impacts of energy projects mainly affect the local host community, any future nuclear project—including SMRs—is unavoidably embedded in international production chains, from uranium mining all the way to waste management. Uranium mining continues to cause numerous significant social and environmental problems globally, the most severe impacts being experienced in the Global South and among marginalised communities in the North (Malin, 2015; Sovacool et al., 2023; van Uffelen, 2022).

In the following, we examine the potential challenges of distributive, procedural, and recognition justice associated with the construction of SMRs in urban areas.

2.1. Distributive Justice

Distributive justice relates to the distribution of benefits and burdens among groups of society: In a just energy system, those who benefit the most also bear the greatest burdens. This is often not the case in current energy systems. Often, those suffering the greatest harms and risks throughout the various stages of energy production and consumption are not the same who enjoy the greatest benefits of energy systems (e.g., access to affordable energy). In their analysis of the French nuclear sector, Sovacool et al. (2019) found that most long-term costs and accident risks fell upon taxpayers and residents near the facilities, both across and within generations, whereas industry stakeholders, financiers, and energy consumers were the primary beneficiaries. Expensive energy projects tend to push up energy bills and indirectly also the price of consumer goods. This would disproportionately hurt the less well-off, with energy costs absorbing a major share of their household budget.

Although expected to be more attractive than large nuclear power plants (NPPs) to the investors, given the smaller financial risk in case of cost overruns, delays, and cancellations, especially the first SMR projects are unlikely to be competitive with for example renewable energy projects (Böse et al., 2024; Kim & Macfarlane, 2026; Schlissel & Wamsted, 2024). In the United States, the NuScale project in Utah, foreseen to be the first SMR in the West, was cancelled in November 2023 as the owners considered the costs excessive. The likely higher costs would disproportionately hurt the poorer households. SMRs would probably require public subsidies, financed by taxpayers, before serial production might reduce costs and make them self-financing.

For techno-economic reasons, district heating SMRs would have to be sited close to the existing heat networks, with major implications for the distribution of costs and benefits among customers. Firstly, although SMR promoters market these reactors as even safer than earlier nuclear technologies, and a possible major accident would probably cause smaller damage than a major large-NPP accident, the local consequences could be significant. The radiation impacts would probably affect a smaller area but a larger number of individuals within the urban host locality. By contrast, the energy supply, employment, and economic benefits would be spread among citizens in the entire greater municipal area. Yet, small size, passive safety, and possibility of remote and automatised operation would also mean less revenue and jobs than a large NPP would generate.

Given that it would likely take years, even decades, for SMRs to become economically viable (e.g., Kim & Macfarlane, 2026; Satymov et al., 2025), the host community residents would bear most of the consequences from "teething problems" such as health and environmental risks and a possible decline in property values. The economic and financial uncertainties would, in turn, be disproportionately borne by the less well-off in society.

The management of nuclear waste from SMRs has received only minor attention. Finland is to become the first country in the world to operate a final disposal facility for spent nuclear fuel (SNF), but the repository is designed only for SNF from the country's five currently operating NPPs. It is uncertain whether the owners of the repository would agree to receive SMR waste in the facility. Moreover, the characteristics of SMR waste would probably differ from those of SNF from Finland's NPPs, thus possibly further undermining the feasibility of a joint solution. A municipality hosting an SMR should prepare for at least the final disposal of low- and

intermediate-level nuclear waste and the interim storage of SNF, possibly for decades. SMR waste likewise raises the same issues of burden- and benefit-sharing across generations as does waste from large NPPs.

2.2. Recognition Justice

Recognition justice relates to the extent to which the society and its dominant institutions acknowledge the identities, dignity, and specificities of vulnerable and marginal groups, and adequately consider them in energy system planning and operation.

Recognition justice is particularly important in the context of SMRs, which are often located within or near urban areas. The challenges of recognition justice concern the positions and needs of young people, the elderly, workers engaged throughout the lifecycle of SMRs, the energy poor, less developed regions, cultural and ethnic minorities, as well as future generations. One key implication of recognition justice is that there is no single "public opinion," but the perspectives, concerns, and experiences of different groups must be examined in a differentiated manner. This requires the development of tailored mechanisms, for example to facilitate the participation of less privileged groups, and institutional mechanisms that allow such groups to influence policymaking. Recognition justice provides a normative foundation for both procedural and distributive justice.

Recognition justice also implies valuing diverse views, experiences, and types of knowledge, with particular attention to the habitually marginalised perspectives. In nuclear-sector planning and decision-making, engineering and natural-science knowledge tends to dominate over other disciplines and experiential citizen knowledge.

2.3. Procedural Justice

Procedural justice denotes the fairness of decision-making processes—the inclusion of diverse participants, perspectives, and kinds of knowledge in national and local-level planning and decision-making. The processes should start from the concerns and objectives of society and the community, and only then explore the potential of SMRs to address those needs and concerns. Likewise, ready access to reliable and impartial information is an indispensable precondition for procedural justice and a foundation for informed consent by local citizens and other energy consumers. Increased public awareness is likely to foster broad participation and thereby enhance the legitimacy of decisions. It can also create pressure for more responsible decision-making at the top level.

The nuclear sector is characterised by a high degree of technical complexity, a technocratic and centralised culture, and a tradition of secrecy and opacity inherited from its military roots (e.g., Sovacool et al., 2019). The sector has made significant progress towards openness and citizen engagement also in Finland. The Nuclear Energy Act requires that residents be given an opportunity to express their opinions throughout the licensing process. Any citizen has the right to express their views on the applications by companies for a government decision-in-principle (DiP).

In practice, the public hearings organised by the Ministry of Economic Affairs and Employment have hardly fostered dialogue between citizens and project promoters. In these hearings, requests to speak must be made in advance (before the hearing begins), the time for comments from the public is limited, and there is

no opportunity for discussion between the audience and the presenters. The central role of energy sector experts and the industry in both decision-making and public debate further undermine the possibilities for equitable engagement with local communities (Ruostetsaari, 2017), as do the exceptionally high value given to engineering knowledge and technical rationality in Finnish energy-sector policymaking, the relatively weak trust in civil society actors, a political culture characterised by a degree of passiveness (Siisiäinen, 1998), and generally positive attitudes toward nuclear power (Energiateollisuus, 2025). Like in other countries and sectors (e.g., Gardiner, 2015, p. 93), the most active participants tend to be the affluent and highly educated. Yet, a recent survey shows that residents of the Helsinki metropolitan area are not willing to cede full decision-making power over SMRs to experts, the energy industry, and politicians (Kojo et al., 2022).

The recently completed reform of the Nuclear Energy Act will have crucial implications for citizen engagement and procedural justice in potential SMR projects. Under the new Act, the DiP is more general in nature than before. It is approved by the government, and needs no parliamentary ratification. For SMRs up to 50 megawatts thermal (MWth), the process is purely administrative, with the Ministry of Economic Affairs and Employment approving the DiP. In addition, under the new Act, the candidate host municipality's favourable statement is no longer requested at the DiP stage, but only later, at the construction licence stage.

3. SMR Promise-Construction in Finland

Nuclear power has been a cornerstone of Finland's energy policy, even though large nuclear projects have faced difficulties (Husu et al., 2025; Jensen-Eriksen, 2022; Litmanen & Kojo, 2011). The chronic challenges of large NPP projects shifted interest towards SMRs, which promised faster construction and lower costs. In Finland, the CEO of the major state-owned energy company, Fortum, opened this debate in the early 2010s, citing climate concerns and growing electricity demand, while emphasising the need for passive safety systems in the wake of the Fukushima accident (Laatikainen, 2013; Niemeläinen, 2011).

The institutionalisation of the SMR promise progressed through R&D programmes that helped establish a dedicated expert community and increase media visibility (Kari et al., 2023). By the early 2020s, two domestic SMR concepts were announced: the LUT Heat Experimental Reactor (LUTHER) and the LDR-50 low-temperature reactor, both designed for district heating applications for the Nordic and European markets. In 2023, the LDR-50 gained a major boost with the founding of the Steady Energy startup to drive the development. The startup had by 2025 raised approximately €32 million in financing ("Steady Energy completes," 2025). Fortum and the Helsinki municipal energy utility Helen also participate in this development work.

Commercial viability remains a central focus. A feasibility study by Fortum concluded that while nuclear energy supports energy independence, security of supply, and carbon neutrality, new projects are not economically viable on a merchant basis alone in the current market. Fortum's suggestion that risk-sharing frameworks similar to those in Sweden would be needed sparked debate on state financial support (AFRY, 2026; Fortum, 2025).

Changes in regulatory and political frameworks have fostered the institutionalisation of the SMR promise. In 2019, a Ministry of Economic Affairs and Employment working group initiated a reform of the Nuclear Energy Act, approved by Parliament in summer 2026. In 2024, the Radiation and Nuclear Safety Authority

(STUK) updated its regulations to allow case-by-case definition of the precautionary action and emergency planning zones for SMRs ("According to STUK's new regulation," 2024).

Currently, the SMR policy is guided by Prime Minister Orpo's government programme (Finnish Government, 2023). In the run-up to the 2023 parliamentary elections, several candidates and parties expressed their support for the construction of SMRs and for a reform of the Nuclear Energy Act (Kojo et al., 2023). Moreover, a group of energy companies published a statement calling for the future government to promote and finance a small-scale pilot nuclear power project (Kari et al., 2023; Tampereen Energia, 2023). This political enthusiasm is mirrored at the local level: As cities face pressure to replace fossil fuels or biomass in district heating, SMR initiatives have been introduced in 9 of Finland's 10 largest cities and in some smaller towns.

4. Data and Methods

The key data consist of the cities' responses to council initiatives regarding SMRs, collected from the cities' websites. In some cases, documents were requested from the cities' archives.

Municipal councillors can submit council initiatives on matters they consider of importance for their municipality. A municipal official then prepares a response on behalf of the municipal executive board. The response may be discussed by a committee, but the final response is given by the municipal (city) council. While the initiative reflects the political objectives of its initiators, the official preparing the response is responsible for the legality, accuracy, and completeness of the response, to ensure that the decision-makers (e.g., the city council) have sufficient knowledge to resolve the matter.

Despite their similarities, the nine city initiatives concerning SMRs also exhibited differences, reflecting the city-specific administrative structures and regulations. The responses varied in content and length, also depending on who prepared the response and whose input within the city corporation was requested.

We used a purposive sampling of case studies to examine the development of the SMR promise in Finland. Finland's government is strongly committed to the use of nuclear power as an energy and climate policy tool, and nuclear power has generated little controversy in recent decades. To understand the country's SMR policy, we provide background information on the institutionalisation of the promise, which is reflected, for example, in policy programmes, legislation, R&D programmes, and investments. We analysed the cities' responses to the SMR initiatives, applying a theory-driven content analysis, with the three dimensions of energy justice applied as the analytical lens.

5. Results

5.1. The Pioneers

The two "pioneers"—Helsinki and Kuopio—have included SMRs in their development strategies, signed preliminary agreements on SMR technologies, conducted related studies, and announced alternative possible sites for SMR plants.

The first council initiative was submitted in Helsinki in November 2017. It proposed that "the city conduct a study on the practical possibilities of using nuclear power to produce district heating for the Helsinki area," mentioning the power plant sites in Loviisa and Inkoo as possible locations (Pennanen et al., 2017). The SMR promise was justified by the low emissions, rapid construction, and passive safety. Further legitimacy was sought by comparing SMRs with the hugely delayed and over-budget Olkiluoto 3 NPP unit: "The new generation of mass-produced miniature reactors is fundamentally the opposite of massive prototype plants such as Olkiluoto 3" (Pennanen et al., 2017).

In its statement on the initiative, Helen (2018) noted that the commercialisation of SMR technology would inevitably take a long time. This would raise questions on how the costs from the long development and possible delays in implementation would be distributed among companies, consumers, and taxpayers. While interested in SMRs, Helen considered technological maturity and technical and economic viability as prerequisites for further investigation, and mentioned the safety zones required for SMRs as a constraint. The City Council's response in May 2018 included a motion calling for investigations on "the possibility of transitioning to a proven low-emission district heating system that does not rely on large-scale biomass combustion by 2035," given the scarce availability of biomass in the Helsinki area, but did not specifically mention SMRs (City Council of Helsinki, 2018).

In October 2023, Helen and Steady Energy signed a letter of intent to enable an investment in up to 10 SMR units for heat production. Three alternative sites in Helsinki were selected for more detailed studies. Helen announced: "Small-scale nuclear power is one of the most promising solutions for rapidly and cost-efficiently reducing the emissions of both electricity and heat production" ("Helen ja Steady Energy," 2023). To achieve non-combustion energy production by 2040, Helen launched its own nuclear energy programme in 2024 to build an SMR for district heating, and plans to construct a pilot SMR.

The upcoming EIA and land-use planning procedures will be crucial for distributive, recognition, and procedural justice. The first public event on the SMR project was arranged in November 2025. In spring 2026, Helen held public events at three alternative locations, thereby addressing concerns regarding procedural fairness.

Kuopio city's municipal energy utility, Kuopion Energia, has investigated the possibilities for replacing the old combined power and heat (CHP) power plant in the 2030s. Together with other energy companies, it commissioned a report on the preconditions for the construction of an SMR (Tampereen Energia, 2023). In December 2023, Kuopion Energia signed a letter of intent to order up to five SMRs from Steady Energy and in July 2024, a preliminary agreement to launch an EIA on potential sites. Six possible locations were announced in 2024, then reduced to two in 2025. Construction start is foreseen for the early 2030s.

From the perspective of procedural justice, Kuopio differs (along with Oulu) from other large cities in that the SMR initiative came from citizens, and not from the City Council (Backnäs et al., 2020a). The aim of the initiative issued in January 2020 was "to launch a preliminary study on the introduction of non-combustion-based technologies to reduce district heating emissions" (Backnäs et al., 2020a). The initiative mentioned SMRs as one possible technology, referring to earlier studies in the Helsinki metropolitan area.

For citizen participation, crucial for procedural justice, Kuopio organised a public event in 2024 and 2025. In 2025, the developer launched the legally mandated EIA, which will offer the citizens both information and an opportunity to express opinions. The energy company also commissioned, in 2025 and 2026, a resident survey on the acceptability of SMRs. In both years, most respondents expressed positive views on SMRs. However, more than 75% of respondents were men, who are known to have more positive attitudes toward nuclear technologies in general and SMRs in particular (Kiviluoma et al., 2025).

The initiators highlighted distributive and recognition justice by arguing that serial production would improve the cost-efficiency of SMRs, especially if the SMRs were ordered jointly with other cities (Backnäs et al., 2020b). The aim of the initiative was "to achieve real emissions reductions and to prepare for possible future changes in the definition of wood's carbon neutrality" (Backnäs et al., 2020a). The initiative argued that a change in the definition would significantly increase the costs of wood-based district heating and, at worst, make it unprofitable, which would in turn result in "considerable costs for both the municipality and individual households" (Backnäs et al., 2020a, 2020b).

5.2. The Early Followers

The "early followers"—Tampere and Oulu—are preparing for the inclusion of SMRs in their land use planning and related studies, but are more cautious than the pioneers, and mindful of economic and financial uncertainties.

A council initiative in Tampere in August 2022 (Kiviranta et al., 2022) proposed exploring sites for district heating SMRs. It argued that being safer and requiring smaller safety zones than large NPPs, SMRs could be sited within the city limits. Initiating the long process of exploration and possible implementation would signal the city's openness to the technology and encourage industry investment, the initiative noted. It acknowledged the uncertainties concerning for example technology availability. However, SMRs were considered a potential component of an energy system that would be sustainable and reliable in the long term, and would also support Tampere's vision of a "city of action" (Kiviranta et al., 2022).

The city administration's response to the initiative in December 2023 saw the future energy choices as essential shapers of municipal land use planning. The Tampere City Council announced in 2023 that a study conducted as part of the city master plan would include an energy scenario including district-heating SMRs. The report resulting from the investigation, prepared by the city's energy company (Tampereen Energia, 2025, p. 66), estimated that nuclear power would have high potential as a combustion-free, carbon-neutral, and compact solution, but the available international SMR designs would have capacity ratings too high for the city's district heating network. As no nuclear district heating plant has been built in Finland, the report considered the licensing of the first one a significant risk. It further deemed densely populated residential areas unsuitable for the plant, for public acceptance reasons, and mentioned four industrial sites, somewhat further away from the city, that would be possible although not unproblematic. The report noted that the subsequent steps would involve more detailed mapping of these locations, followed by EIAs and land use planning (Tampereen Energia, 2025, p. 68).

The report stated that "the construction and operation of nuclear district heating is poorly suited to the business operations of district heating operators" because of the specialised expertise needed for the safe operation,

maintenance, and handling of nuclear fuel (Tampereen Energia, 2025, p. 67). However, the company considered the costs reasonable compared to alternatives. Because thermal reactors for heat production are simpler than those for electricity generation, cost escalation during R&D would be less likely (Tampereen Energia, 2025, p. 67). Consequently, the company deemed nuclear heating as a plausible and economically reasonable future option. From the perspective of distributive justice, it is notable that the report highlighted the crucial role of the state, given that "with social acceptance, the state can provide feasible regulation and reduce economic risks for the operators" (Tampereen Energia, 2025, p. 67). According to the company, the operation would require public investment until market competitiveness would be reached.

In Oulu, a local resident's initiative issued in October 2022 (Tuomikoski, 2022) proposed investigating SMR siting and city plan modifications. Like the Tampere proposal, it highlighted benefits such as cost predictability, carbon neutrality, electrification, safety, and energy self-sufficiency, while acknowledging legislative and technological uncertainties. Stressing procedural foresight, the initiative argued that the city must prepare well in advance for the long process of SMR siting.

Noteworthy from the perspective of procedural justice is that the city administration's response from October 2022 considered that while SMRs' small land requirements simplify city planning, the lack of specific legislation and regulatory requirements for SMRs constitutes an impediment. Importantly for distributive justice, the response argued that more information would be needed concerning the investment, "the cost of the energy produced, and thus the payback period" (Oulu City Central Administration, 2022).

The response also pondered whether the residents in and around Oulu would accept an SMR close to a residential area. As part of a broader report on energy transition and assessment of the climate impact from land use, the city commissioned a separate report on SMRs in the Oulu area. The report evoked the need to study renewable energy sources and SMRs up to 2040 in preparation for the new urban area master plan (Council of Oulu Region, 2023, p. 48).

5.3. The Cautious Majority

The cities in this category (Espoo, Lahti, Pori, Turku, Vantaa) intend to monitor technological development and possibly reconsider the matter from the 2030s onwards. These cities are generally positive towards SMRs but point to obstacles that currently prevent their deployment.

As early as December 2017, an Espoo council initiative urged the city to explore nuclear district heating in cooperation with regional partners (Kähärä et al., 2017). It presented SMRs as a quick and safe solution for phasing out coal and achieving Espoo's ambitious carbon neutrality targets. After a vote in June 2018, the City Council rejected the initiative and further nuclear plans. As reasons, the response mentioned safety, the safety zone, nuclear waste management, and the need for a reference facility (Espoo City Council, 2018).

The Sustainable Espoo Development Programme for 2021–2025 nevertheless mentioned the possibility of investigating SMRs (Espoo City, 2022, p. 19). The Carbon-Neutral Espoo 2030 Roadmap (Espoo City Council, 2024, p. 36) and the Espoo 2060 Master Plan background report (Espoo City Planning Department, 2024, p. 35) also include references to urban planning related to SMRs. However, the latest city strategy, approved in 2025, does not mention SMRs. The city's goal is to be carbon-neutral by 2030.

In Turku, three council initiatives were made in 2018, 2023, and 2025. According to the latest initiative, SMRs "offer an efficient and environmentally friendly solution for energy production and are particularly well suited for heat production" (Vähä-Heikkilä et al., 2025). To legitimise the promise of SMRs, the initiative qualified SMRs as emission-free, nearly 100% efficient, safe, and able to reduce the dependence on fossil fuels and biomass combustion. Noteworthy from the perspective of distributive justice was that the initiative described SMRs as a means of improving energy security and reducing residents' heating bills without the need for public funding (Vähä-Heikkilä et al., 2025).

In its response, in October 2025, the Turku City Council referred to a recommendation from Turku Energia to reject the idea of an extensive independent study on SMRs. The company monitors technological developments but does not view SMRs as a short-term solution. The reasoning was based on distributive justice, namely the view that the costs, risks, and benefits could be assessed in detail only "once the first pilot plants have been completed" (Turku City Council, 2025). The response also pointed out that no district-heating SMRs have yet been built, and that the risks and uncertainties could be "minimised by monitoring the experiences of pilot projects" (Turku City Council, 2025). The response also mentioned that SMR technology was very capital-intensive, and that "as a result of the investment, the capital costs of district heating would increase to approximately three times the current level, and the district heating total price would have to be raised by approximately 30–35%" (Turku City Council, 2025).

In November 2021, a Vantaa City Council initiative proposed that the city conduct an SMR study "following the example of Helsinki and Espoo" (Weckman et al., 2021). According to the initiative, nuclear power cannot be ignored "if the world wants to move away from fossil fuels within the timeframe required by climate change" (Weckman et al., 2021). SMRs are no longer a futuristic concept but are expected to be in use within 10 years, and should therefore already be integrated, for example, in city planning, the initiative argued.

In its response in January 2022, the city board rejected the need for SMRs "for carbon-negative heat production at this stage" (Vantaa City Board, 2022), as energy production of the Vantaa City energy company would be carbon-negative by 2030 even with the currently planned policies. The company continues to monitor SMR developments and sees them as a possible long-term option, but still far from being a feasible "solution for achieving the metropolitan area's carbon neutrality goals" (Vantaa City Board, 2022).

In Pori, a council initiative in December 2022 called for investigation of suitable locations for an SMR, to prepare for the needed changes to the city plan and other necessary measures (Lahto et al., 2022). The initiative referred to studies initiated by several other Finnish cities and considered that Pori should also prepare well in advance, to promote energy self-sufficiency and send a positive signal to companies in the sector.

In its response in April 2023, the city stated that siting plans could not yet be initiated, for lack of clear criteria and legislative guidance (Pori Vitality and Environment Committee, 2023). A broader study of SMR siting would thus "be timely in the 2030s at the earliest" (Pori Vitality and Environment Committee, 2023). Pori Energy is expected to decide in the 2030s whether to invest in nuclear district heating, following the completion of technical development and reform of the siting legislation. Factors influencing the decision would include the acceptability of combustion, taxation policy, the technical service life of existing CHP plants, competing technologies, SMR financing models, and the evolution of district heating demand in Pori.

However, the city had included SMRs as one of the planning targets in the reform of the Satakunta regional plan, which states a green energy transition as a key objective.

In Lahti, a council initiative issued in March 2023 proposed investigating suitable locations for SMRs and surveying residents' opinions on electricity- and heat-producing SMRs (Lahti Social Democratic Council Group, 2023). This would be in line with the city's industrial image, carbon neutrality goals, and energy self-sufficiency, the initiative argued. The city response in October 2023 referred to a VTT report (Tulkki et al., 2022) on the feasibility of SMRs for district heating, mentioning the lack of experience, regulatory uncertainty, and the low maturity level of the technology (Lahti City Council, 2023). The city would monitor technical and legislative developments but estimated that the technology would be applicable "at the earliest in the late 2030s" (Lahti City Council, 2023).

6. Conclusion

The institutionalisation of the SMR promise is underway in Finland, manifested in legislative reforms, financing, and city council initiatives designed to facilitate the materialisation of the promise. By January 2026, the councils of nine of the 10 largest cities in Finland had discussed such initiatives. While city-level SMR initiatives raised a variety of potential justice issues, these have thus far played a minor role in efforts to either build or undermine the legitimacy and credibility of the SMR promise. However, if projects advance towards implementation, questions of energy justice will likely generate debates in the potential host cities, especially as part of the mandatory EIA procedures. Potential topics include the distribution of risks and benefits in densely populated urban areas, cultural and socio-economic diversity, the impacts on marginal and vulnerable groups in cities, as well as questions of trust, participation, and transparency of decision-making.

While the largest cities in Finland are positive about SMR technology, their responses to the SMR initiatives differ from each other. The "pioneer" cities have launched preliminary agreements on planning, preliminary site selection, and preparation of the EIA procedure. The "early followers" are more mindful of uncertainties related to investment and energy prices but prepare for possible SMRs in their land use planning and related studies. The "cautious majority" sees obstacles to SMR technology deployment currently but monitors technological development and may reconsider the matter in the 2030s.

Energy justice considerations were typically related to uncertainty about investing in yet unproven technology, legislation, site selection, and in some cases, social acceptability. Although nuclear waste management was mentioned in some cities, no proposals were made to investigate the issue. Global justice issues related to the front-end of the fuel cycle were not addressed.

Significant from the perspective of distributive justice was the recognition that state support would be needed to make SMRs economically viable. The costs of technology development and the risks of cost escalation may fall on pioneer cities, especially their more vulnerable population groups, given the immaturity of the technology and the regulatory uncertainties. To mitigate such risks and uncertainties, the cities call for government funding for R&D and streamlining of SMR regulation.

Earlier research on nuclear-sector policymaking has highlighted a number of Finnish idiosyncrasies as a high-trust society with strong pro-nuclear consensus, high trust in experts and state administration, a long tradition of strong local autonomy, and a pioneer role as the likely first country in the world to operate a high-level nuclear waste repository (Husu et al., 2025; Litmanen & Kojo, 2011). In countries with more negative public attitudes towards nuclear power, greater mistrust of experts and authorities, and reduced local autonomy, justice challenges associated with SMRs would likely be somewhat different. In particular, one would expect more controversy-laden debates on, for example, the health and environmental risks, the principles of site selection, government subsidies, nuclear waste management, and above all the fairness of the planning and decision-making processes. However, we contend that our overall conclusions are applicable to SMR plans in general (little justice debates at the early stage, hence the need for analysis such as ours). Furthermore, our data—administrative documents—probably do not fully reflect the views of residents, civil society actors, and vulnerable groups, even in a country like Finland, with its highly-developed local democracy. The nuances surrounding energy justice will undoubtedly become more apparent when the debates reach broader publics. This was evident in Finland as well, where public events were held in Helsinki and Kuopio in the spring of 2026. However, by scrutinising administrative plans and municipal SMR initiatives from an energy justice perspective, we hope precisely to draw attention to such possibly overlooked themes, and thereby lay the basis for more informed and inclusive processes of SMR planning and decision-making.

The materialisation of the promise—the construction of pilot, let alone commercial, SMRs—is still uncertain and years away. However, as the SMR projects advance towards implementation, the role of justice considerations in shaping especially the legitimacy of the promise will certainly increase. Such considerations should not focus only on the habitual distributive questions. Especially given the current highly pro-nuclear atmosphere and pressures towards regulatory streamlining, efforts are needed to ensure that democracy, procedural justice, and recognition of the needs of different population groups are not trampled in the name of speedy deployment of SMRs for decarbonisation.

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Conflict of Interests

The authors declare no conflict of interests.

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About the Authors

Matti Kojo (Associate Prof.) is a social scientist whose research has focused on nuclear energy and waste governance.

Markku Lehtonen (PhD) is a social scientist whose recent research has focused on megaprojects, techno-scientific promises, and public controversies in the nuclear energy sector.

Anni Vainio (Bachelor of Social Sciences) is a master's student in sociology with an interest in various environmental topics.

Tapio Litmanen (Prof.) is an environmental sociologist whose research has focused on environmental and health risks, particularly those related to nuclear technology.