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# Perceptions of justice influencing community acceptance of spent nuclear fuel disposal. A case study in two Finnish nuclear communities

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## ABSTRACT

Final disposal of spent nuclear fuel (SNF) from nuclear power plants (NPPs) is an ethical issue with implications within and across generations. We address this issue from the perspective of nuclear communities that host nuclear waste disposal sites. These are primarily the communities that face injustice due to the potential radiological risks. A resident survey ( $n = 454$ ) was conducted in two Finnish nuclear communities, i.e. Eurajoki and Pyhäjoki, that are being considered as alternative sites for a second repository for SNF. The nuclear waste management (NWM) company Posiva is already building a repository in Eurajoki, the first in Finland. These communities are in different stages of their lifecycles as nuclear communities. We investigated the residents' conceptions of justice and trust regarding the repository SNF management and its main actors, and how these conceptions related to acceptance of the repository. The main findings show that residents of both communities perceived intragenerational and intergenerational injustices to be important in the procedures and the distribution of risks and benefits of the proposed repository. Claims regarding justice and trust were related to the acceptance of the repository. The community with the longer history with NWM expressed greater mistrust and perceived greater procedural injustice than the community with less earlier experience, which – in turn – expressed more concern over intragenerational distributive justice than the former community. Moreover, having longer history with NWM did not lead to a different understanding regarding responsibility toward future generations as residents in both communities expressed similar concern over intergenerational justice. Moreover, having more experience of NWM did not enhance local acceptance. We emphasize that these results should be understood in the light of the prevailing situation in Finland, where the planning of the second repository is at a very early stage.

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## 1. Introduction

Radioactive waste management inevitably involves ethical issues, but frequently these issues have been reduced to a question of social acceptance. However, by focusing solely on social

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acceptance important ethical aspects, such as intergenerational justice and technological risk may be overlooked (Taebi 2017). Final disposal of spent nuclear fuel (SNF) is an example of such technology currently under evaluation. Hannis and Rawles (2013, 350 – 351) argue that acceptance is a necessary but not a sufficient condition for ethically legitimate nuclear waste management (NWM). Ethically legitimate NWM requires that public acceptance is not pursued by ethically questionable approaches such as bribery.

The moral issues of NWM have mainly been addressed by international authorities, however, mostly from a more abstract rather than a practical perspective. For instance, the International Atomic Energy Agency (IAEA), the Nuclear Energy Agency (NEA) and the OECD have been influential actors in both raising and addressing moral questions, for instance concerning what intergenerational equity should be taken to mean in NWM (NEA-OECD 1995). The principles outlined in the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management are globally considered the leading principles, and they include various ethical matters (IAEA 1997). These ethical principles have been abundantly discussed and criticized by several scholars, for instance for underestimating the inequity that future generations will face due to the risks and burdens involved in the geological disposal of SNF (Shrader-Frechette 1993; Andrén 2012, 36 – 38; Taebi 2012a).

A key challenge among the ethical issues concerning NWM, as they have been discussed in the literature, is that they are often not empirically substantiated (Taebi 2017). One specific branch in the literature that has specifically looked into the views of local communities, namely environmental justice, has mainly studied local communities having different ethnic minorities (Wigley and Shrader-Frechette 1996; Gowda and Easterling 2000; Shrader-Frechette 2000, 2002; Fan 2006; Huang, Gray, and Bell 2013). In these studies, it has been found that the local residents belonging to ethnic minorities face intragenerational and intergenerational injustice and are also mistrustful of the siting of nuclear waste facilities. The latter questions of justice are not directly comparable to a society, such as that in Finland, which has a high level of trust in authorities and experts and where the host municipality is vested with the right of veto on siting. Therefore, it is worth discussing cases, such as that of Finland, where there is less criticism toward engagement and still many important justice issues to be discussed.

This study seeks to contribute to the findings reported by Krütli et al. (2015) and some others (e.g. Stefanelli, Seidl, and Siegrist 2017) by showing how ethical questions are perceived by residents of prospective host communities. We argue that more empirical research on how lay people perceive ethical issues related to community acceptance of an SNF repository is needed in order to better understand the ethical issues at local level. We further investigate how residents of two Finnish ‘nuclear communities’ perceive ethical issues related to the final disposal of SNF. We also study how ethical perceptions correlate with the acceptance of the final disposal of SNF. The case of Finland’s second repository for SNF allows us to compare perceptions of justice in two different types of municipalities, which differ in terms of their respective developmental stages as nuclear communities. Our conceptual framework is in part based on Blowers’ (1999, 2003, 2016) thesis on nuclear communities, which builds on the inequality of the relationship between the industry and the host community. Blowers (2016, 229) argues that the nuclear communities ‘have a moral claim on society for bearing a burden that others are happy not to carry. (...) There is the claim of intra-generational equity, that is fairness between places; and there is intergenerational equity, fairness between generations.’ These communities are at different stages on ‘a continuum based on how long they have been established and how stable the relationship is between nuclear communities and the nuclear industry they support and on which they depend’ (Blowers 2016, 4). Moreover, Finland as a society seems to enjoy the discourse of trust in technology even today – trust which used also to be more common elsewhere in the world in the early days of the nuclear industry (Blowers 2016, 14–15). Furthermore, in order to study how perceptions of justice correlate with community acceptance, we apply the framework of community acceptance proposed by Wüstenhagen, Wolsink, and Bürer (2007) where it is

suggested that procedural justice, distributive justice and trust are components of community acceptance. The central argument we make is that the municipalities of Eurajoki and Pyhäjoki are different in terms of how familiar they are with nuclear issues, with Eurajoki being a nuclear oasis having decades-long experience of living with nuclear power and its legacy, and Pyhäjoki still being a greenfield community that has recently approved the locating of a nuclear power plant (NPP) in the municipality. Our research questions are: First, do perceptions of justice and trust with respect to SNF disposal vary between the two communities, i.e. a nuclear oasis and a greenfield community? Second, how do ethical perceptions correlate with the acceptance of the final disposal of SNF in each of the two types of communities?

The structure of this article is as follows. In [Section 2](#), we focus on the concept of community acceptance and its ethical dimensions, as well as on a broader picture of ethical issues related to NWM. [Section 3](#) is devoted to describing the context of the two Finnish nuclear communities. In [Section 4](#), we introduce our survey data and in [Section 5](#) the results. In [Section 6](#), the conclusions are drawn.

## **2. Debating social acceptance and ethical issues in nuclear communities**

This article builds on two separate lines the literature, namely that presented on nuclear communities by Blowers and the literature on public acceptance in general and the acceptance of NWM. Both of these emphasize the role of ethics in decision-making. More specifically, they emphasize the role of justice and trust as two important ethical issues of NWM. In the following sub-sections, we will first introduce each line as mentioned here. In the third sub-section, we will introduce our approach (that brings these two strands of research (together) arguing among other things why we need a better understanding of the perceptions of justice and trust in the local communities.

### ***2.1. Nuclear communities and justice: Blowers' nuclear oases and nuclear greenfields***

Let us first focus on a distinction between different types of nuclear communities and why this distinction matters for understanding public acceptance. Blowers (1999, 2003, 2016) argues that nuclear communities reflect the mechanisms that produce social, environmental and political inequality, and these inequalities should be redressed to ensure acceptable or long-lasting decision-making. Other site typologies have been proposed (Di Nucci and Brunnengräber 2017), but we follow Blowers' thinking as it includes the idea of the changing (or degeneration) of the relationship with the nuclear industry, which we find important in such a long-term project. Blowers (1999) divides nuclear communities into nuclear oases that have long established nuclear industry-related activities, and greenfield communities, which have hosted these activities for less than two decades. Blowers claims that nuclear oases are remote, since they are geographically isolated and peripheral places. They are economically marginal, which in some cases has led to economic dependence on the nuclear industry. The power of nuclear oases to influence the decisions affecting them is often restricted and they are subject to powerlessness. Blowers (2003) states that economic marginality and powerlessness give rise to political inequality, which can be redressed by transparent governance, providing information and opportunities to participate in decision-making and in some cases by given the community the right of veto. In addition, he argues that nuclear communities are subject to environmental injustice because they often suffer from environmental degradation, or they are subject to environmental risks from nuclear activities. Blowers (2003) suggests that environmental injustice can be redressed by minimizing environmental risks through environmental protection and argues that ensuring intergenerational justice, which, he claims, is a key issue in the sustainable management of nuclear waste, is uncertain.

The key argument in Blowers' conceptual framework of nuclear communities is the power relationship between the location, the industry and society concerning the legacy of nuclear power. In the case of the nuclear community geographical remoteness, economic marginality and political powerlessness have led to a culture of acceptance, or what Blowers calls a 'nuclear culture', where the nuclear activities are supported without much resistance, although sometimes there is also sense of pride and patriotism due to the recognition of their role in the eyes of industry and society at large.

While Blowers refers to issues pertaining to procedural and intergenerational justice and theoretically ties community acceptance to perceived justice (or rather injustice), – his empirical approach – though rich and substantial – does not specify the perceptions of justice held by the local residents. This article empirically investigates this issue in two types of nuclear communities in Finland. Before elaborating on our approach, let us first review the literature on public acceptance.

## ***2.2. Nuclear waste disposal, justice and public acceptance: ethical versus empirical studies***

Nuclear energy production and the management of the waste produced have given rise to a host of important ethical issues. These issues have been abundantly discussed in the ethics and philosophy literature. They include (but are not limited to) the ethics of risk – i.e. who will be exposed to radiation and what levels of radiation exposure are deemed acceptable – distributions of risks and benefits – what distribution scheme has been presented (why) is that fair, (how) do we compensate for the losses and damage – the legitimacy of the temporal transfer of risk – who in the future will be exposed to radiation risks (why) is that legitimate – and decision-making procedures as to who will be involved in the decision-making, how to deal with expert and lay people's knowledge, how to deal with the moral emotions of different stakeholders as well as the much desired *trust* when it comes to the siting of risky facilities (Shrader-Frechette 1993, 2002, 2005; Löfqvist 2008; Roeser 2010, 2011; Basta 2011; Taebi, Roeser, and Van de Poel 2012; Taebi and Roeser 2015). When it comes to NWM, the ethical concerns are often centered around local communities, pertaining to questions of distributive justice (e.g. sharing environmental goods and ills equally) and procedural justice (e.g. fairness in participation in the decision-making process). Nuclear waste raises temporal and spatial concerns since it potentially threatens the safety of present and future generations. The distribution of the risks inherent in nuclear waste and benefits of nuclear energy between and within generations is a difficult ethical problem, especially when it comes to the geological disposal of SNF, which retains its radioactivity for up to 200,000 thousand years (Shrader-Frechette 1993; Taebi and Kloosterman 2008). What makes this discussion particularly intriguing from an ethics point of view is that complying with the demands of (spatial) procedural justice could potentially conflict with those of (temporal) intergenerational justice, for instance when it comes to questions of the multinational disposal of nuclear waste.<sup>1</sup>

The conceptual philosophical discussions on the ethics of nuclear waste – including those discussions on justice – often remain purely conceptual and therefore lack empirical substantiation (Taebi 2017). The empirical literature in social sciences has of course also engaged with these discussions. There are some studies which approach the ethical issues of NWM from different theoretical perspectives/conceptual frameworks (see e.g. Krütli et al. 2012; Huang, Gray, and Bell 2013; Ocelik et al. 2017). Intragenerational and intergenerational injustice has been found to be influential in community debates on NWM (Kojo, Kari, and Litmanen 2012; Huang, Gray, and Bell 2013; Ocelik et al. 2017). Huang, Gray, and Bell (2013) discovered that the justice issues that opponents of nuclear waste siting in Taiwan experienced pertained to spatial and temporal injustice. The opponents raised the intragenerational distributive injustice issue: the risks of

nuclear waste would be inflicted on the local community while the benefits of nuclear energy would be felt in the larger cities of Taiwan. In addition, procedural injustice concerns were expressed, including having received little or no information on the NWM project, not having equal or indeed any opportunities to participate in the siting process as well as a lack of trust in the government and the power company. Gowda and Easterling (2000) report similar results, that residents in Native American communities who were subjected to the siting of a nuclear waste reprocessing facility raised intergenerational and intragenerational equity concerns, including inequity of the outcomes and procedures. Ocelik et al. (2017) recently found in their study on a nuclear waste repository siting in the Czech Republic that there was a conflict between different notions and interpretations of justice in the views of community leaders (Mayors). The supporters framed the repository as a responsible option for future generations whereas the opponents framed it in terms of a risk to the local community and the natural environment. Stefanelli, Seidl, and Siegrist (2017) argued that justice and responsibility were the major concerns expressed by lay people regarding the planned repository siting in Switzerland. Justice and responsibility were discussed even more often than the safety and the risks of nuclear waste. They further state that the interpretations of justice and responsibility were the main concern for those who were strongly in favor of the repository.

According to Wüstenhagen, Wolsink, and Bürer (2007) perceived justice of procedures and outcomes are key factors that influence the community's acceptance of a new project. Community acceptance refers to the acceptance of siting decisions by local residents and authorities, and includes procedural justice, distributive justice and trust dimensions. Wüstenhagen, Wolsink, and Bürer define community acceptance as one dimension of social acceptance. Several studies have addressed how perceptions of justice affect social acceptance of new technologies, energy policy decisions, risks and hazards (Sjöberg and Drottz-Sjöberg 2001; Besley 2010; Visschers and Siegrist 2012). The research so far suggests that both distributive justice (or outcome fairness) and procedural justice (or process fairness) affect acceptance, and their relevance is influenced by the perceived moral importance of the issue in question (Skitka, Winquist, and Hutchinson 2003; Besley 2010).

There are some quantitative studies on how lay people's perceptions of justice have influenced the social acceptance of nuclear waste facilities (Krütli et al. 2012, 2015; Seidl et al. 2013). Sjöberg and Drottz-Sjöberg (2001, 75–76) argue that around the world local opposition to siting nuclear waste facilities has largely entailed debating moral questions, such as what is perceived as a fair siting process and what responsibilities there are toward future generations. They have found that the perceptions of the moral implications of the risk correlate with its local acceptance in the context of nuclear waste siting in Sweden. Krütli et al. (2012, 2015) studied residents' perceptions of distributive and procedural fairness related to NW repository siting in Switzerland. Their findings support the claim that procedural fairness, such as having a voice and being treated fairly by others, has a greater influence on decision acceptance than distributive fairness. Krütli et al. (2015, 95–97) also state that context-specific factors, such as energy policy, can have an impact on the perceived fairness of repository siting. Seidl et al. (2013, 110–114) found that values and value-related concepts, such as security and general fairness affect judgments of acceptance of a repository differently depending on whether the respondent is directly affected. However, a difference between affected and non-affected respondents only emerged when they were asked about siting the potential repository in the respondents' own community. There was no difference about the acceptance of a repository in some indeterminate location in their country. Seidl et al. (2013) also suggest that a positive or negative attitude toward repositories can be influenced by the same values, such as safety. The results of these studies suggest that public acceptance has a relation to the perceived justice of nuclear repository. However, there is a room for further studies on how justice and acceptance are related, especially when we distinguish between different types of nuclear communities with different levels of past experience of

hosting nuclear energy activities and living with the legacy. Also, as Krütli et al. (2012) point out, further research is needed on the different aspects of justice in nuclear waste issues.

### **2.3. Bringing nuclear communities, justice and acceptance together: our empirical study**

In this study, we investigate the ethical issues (more specifically issues of justice and trust) and their correlation with the community's acceptance of SNF disposal in two different types of communities, namely a nuclear oasis and a Greenfield Community. Following the social scientific literature mentioned above assessing these ethical issues mostly in terms of justice, but also building on the conceptual philosophical analysis of this matter emphasizing the relevance of justice in addressing ethical issues (Shrader-Frechette 1993, 1994; Löfquist 2008; Taebi and Roeser 2015; Pesch et al. 2017) we contend that the ethics of NWM could best be considered in terms of the justice issues it gives rise to, both procedural and distributive. This also concurs with a recently emerging line in the literature on *energy justice* (Sovacool and Dworkin 2014; Jenkins et al. 2016) that emphasizes the increasing attention to understanding the justice issues in energy-related decisions. In this study, in addition to distributive justice (pertaining to the distribution of burdens and benefits) and procedural justice (relating to decision-making), we identify intergenerational justice, trust in and ethical attitudes toward nuclear energy. This requires some explanation.

While intergenerational justice could be considered (mostly) under the heading of distributive justice, we chose to treat it as a separate item in the questionnaires. This emphasis is not only justified because of the relevance of this notion in national and international policy-making on nuclear waste disposal, but also because separate discussion enables us to make a crucial empirical distinction between present, near and distant future generations. This distinction has generally been overlooked in the literature, while it is a crucial distinction with significant implications for different choices in nuclear waste disposal (Kermisch 2016; Kermisch and Taebi 2017). Only few empirical studies that have scrutinized the subject and the results suggest that lay people perceive the risks of repository siting differently depending on whether the focus is on present, near or distant generations (Drottz-Sjöberg 2010; Kojo, Kari, and Litmanen 2012; Seidl et al. 2013). Trust is a notion that could be placed under the heading of procedural justice and in conjunction with rules and procedures for decision-making. However, we decided to follow Wüstenhagen, Wolsink, and Bürer (2007) in their approach to acceptance, whereby they include trust as a separate item from procedural and distributive justice. Regarding 'ethical attitudes to nuclear energy', we present broader perspectives of how people consider nuclear energy, which is why we refer to this as 'ethical attitudes', but only in relation to the nuclear energy debate. In this study, we will examine nuclear communities' residents' perceptions of justice and trust and what implications these may have for community acceptance of SNF repository siting by investigating survey data using mostly descriptive methods. The study results will yield indications of the justice issues of NWM in a forerunner country, and more specifically in the nuclear communities, regarding SNF disposal.

### **3. Two Finnish nuclear communities**

Finland is currently considered a global front-runner in the implementation of the final disposal of SNF. One milestone was the construction license for the final disposal facility for SNF at the Olkiluoto site in the Finnish municipality of Eurajoki issued by the government in 2015 (Litmanen et al. 2017). According to the schedule, the SNF management company Posiva will start the operation phase of this facility in the 2020s. However, despite progress, a new dispute on joint national disposal has arisen and a new site selection process for the second facility for SNF was launched in Finland in 2016. Posiva is a private company taking care of the final





Figure 1. Map of Pyhäjoki and Eurajoki as alternative locations for Fennovoima's SNF repository (Source Fennovoima 2016, Figure 2.1).

disposal of SNF produced by its owners only, i.e. the nuclear power companies Teollisuuden Voima and Fortum Power and Heat. According to the Finnish Nuclear Energy Act waste management responsibility covering implementation and costs rests with the waste producers, i.e. nuclear power companies. Although Posiva has been exhorted by the authorities and politicians to collaborate with the nuclear power company Fennovoima, Posiva has so far agreed to provide Fennovoima with expert services only, but has refused the joint national final disposal at Olkiluoto site in Eurajoki (Kojo and Oksa 2014).

Fennovoima is planning the construction of a new NPP unit in the municipality of Pyhäjoki (Figure 1). Due to government requirements, (Finnish Government 2010) concerning NWM for the NPP Fennovoima needed either an agreement on the joint final disposal of SNF with the owners of Posiva or an Environmental Impact Assessment program for a repository of its own by June 2016. As the former failed, Fennovoima (2016) launched an Environmental Impact Assessment program for siting a SNF repository. The company proposed the municipalities of Pyhäjoki and Eurajoki as alternative host communities. Neither of the communities was asked to give consent for the site investigations.

**Table 1.** Eurajoki and Pyhäjoki as nuclear communities.

	Eurajoki as a nuclear oasis	Pyhäjoki as a greenfield community
Geological remoteness	9400 residents, population density 18.35/km <sup>2</sup> Distance from the town of Rauma (40,000 residents) 15 km and Pori (85,000 residents) 35 km	3200 residents, population density 5.91/km <sup>2</sup> Distance from the town of Raahe (25,000 residents) 28 km and Oulu (200,000 residents) 100 km
Economic marginality	Income tax rate 18.0% Unemployment rate 12% TVO and Posiva the largest private employers. Furthermore, thousands of fixed-term employees at the OL3 NPP unit construction project  Municipal economy dependent on tax revenues from the nuclear power company, in 2016 property tax revenue alone around 16.3 M€ + income tax revenue from jobs	Income tax rate 20.25% Unemployment rate 12.6% About 30 out of 300 Fennovoima employees located at Pyhäjoki in March 2017. At the operation stage, the NPP will have about 400–500 workers <sup>13</sup> Estimated forthcoming property tax revenue around 3.5–5 M€ annually
Political powerlessness	According to the Nuclear Energy Act, the municipal council of a proposed site has the right of veto on a siting	According to the Nuclear Energy Act, the municipal council of a proposed site has the right of veto on a siting.
Culture of acceptance	Currently no active local anti-nuclear group. Among the residents high trust in the safety regulator. 48% of residents agreed that production of electricity with nuclear energy is ethically justified	Active local anti-nuclear group, Pro Hanhikivi. Among the residents high trust in safety regulator. 57% of residents agreed that production of electricity with nuclear energy is ethically justified.
Environmental risks	No severe nuclear accidents. Local concerns about impacts of cooling waters of NPP on sea and fishing	Fear of radiation. Local concerns about impacts of cooling waters of NPP on sea and fishing

Eurajoki and Pyhäjoki are regarded as nuclear communities although they are at diverse phases. In Eurajoki at the Olkiluoto site the NPP units started up, respectively, in 1979 and in 1982. Eurajoki was named as one alternative host for an SNF repository in the mid-1980s. Currently, the third NPP unit is under construction as well as Posiva's facility for the final disposal of SNF. A facility for low and intermediate-level operating waste is also located at Olkiluoto. Thus in Blowers' (1999, 2016) terminology, Eurajoki can be regarded as a nuclear oasis with a history of nearly four decades with this technology whereas Pyhäjoki is a greenfield community. The site selection process for the Fennovoima NPP started in 2007 and in 2011 the Hanhikivi site in Pyhäjoki was chosen. Construction of the site infrastructure began in 2015, but the construction license for the NPP is still under review. Pyhäjoki (where the Sydänneva site is located) is also a candidate for hosting the SNF repository for waste produced by Fennovoima NPP. However, the municipality of Pyhäjoki took a negative stand on siting the repository on its territory as it argued for joint national disposal at the Olkiluoto site in Eurajoki.

As Blowers and later Bergmans et al. (2008) noted, efforts to site nuclear waste facilities have focused on communities already hosting nuclear activities. Blowers (2016) introduces five key characteristics of peripheral communities for a better understanding of the relationship between a host community and hazardous industrial activities often called 'locally unwanted land uses'. In Table 1, Eurajoki and Pyhäjoki are evaluated from the viewpoint of geographical remoteness, economic marginality, political powerlessness, culture of acceptance and environmental risk.

First, although remoteness is a relative concept, even by Finnish standards both municipalities are rather remote even though they are not located in the most distant and most sparsely populated areas of Eastern and Northern Finland. Pyhäjoki (population density 5.91/km<sup>2</sup>) in particular is well below the average population density of Finland (17.4/km<sup>2</sup>). The population of Eurajoki is significantly higher (9400) than in Pyhäjoki (3200). In terms of economic marginality, the municipal economy of Eurajoki is nowadays strong due to tax revenue from the nuclear industry. The

community tax (18.0%) is lower than in Finnish municipalities on average (19.91%) whereas in Pyhäjoki it is higher (20.25%). However, it should be noted that in the 1990s, when the position of Eurajoki on the siting of the repository and the new NPP unit were debated, the municipal economy was weaker. Already at that time, it was dependent on tax revenues from NPP (Kojo 2009). In Pyhäjoki expectations regarding benefits for the municipal economy have been raised (Fennovoima 2014, 2016), but they have not yet been realized as the NPP is still in its early construction stage. When considering the suitability of a nuclear community approach in the cases of Eurajoki and Pyhäjoki, the evident contradictions with Blowers' terminology concern power and environmental risk. In Finland, a proposed host municipality of a nuclear facility is vested with the right of veto on siting, to be exercised by the elected municipal council. In both municipalities, anti-nuclear groups have submitted petitions to the municipality for an advisory local referendum on the siting of NPP, but with no success. Although the host municipalities still have political power on siting in matters of the final disposal concept, i.e. technology, they are powerless. For example, compared to Sweden the Finnish host communities have no funding available for independent review and communication activities, which puts them in a poor position to process any expert knowledge related to final disposal. In terms of environmental risk, neither municipality suffers from serious environmental degradation, although warming of the sea due to the cooling waters of the NPP has been an issue in Eurajoki. The environmental impacts and radiation risk of the NPP were also debated in Pyhäjoki (Syrjämäki, Kojo, and Litmanen 2015). In terms of a culture of acceptance, the majority of the residents in both municipalities supported nuclear power (See Figure 2 in Section 5). A local anti-nuclear group Pro Hanhikivi has been active in Pyhäjoki until recent years whereas in Eurajoki local anti-nuclear groups have more or less faded away in spite of protesting in the past (Suominen 1998). Part of the culture of acceptance in both municipalities is a high level of trust in the safety regulator but to some extent to the utilities, too (see Figure 3 in Section 5). Trust in authorities and experts is characteristic for Finns in general (Melin 2009; Kiljunen 2016).

#### 4. Data and methods

The data ( $N=454$ ) was gathered in Pyhäjoki, Eurajoki and the municipality of Luvia by means of a telephone survey conducted by the marketing research company Tietoykkönen. In Pyhäjoki, the telephone survey took place between 30 December 2016 and 6 January 2017. In Eurajoki and Luvia, the telephone survey took place between 29 November 2016 and 5 January 2017. The municipality of Luvia, adjacent to Eurajoki, was merged with the municipality of Eurajoki on 1 January 2017 and, therefore, the responses of Luvia are now combined with the responses from Eurajoki. The target groups were the residents aged 18 years and older in these three municipalities: Pyhäjoki, Eurajoki and Luvia.

The sampling method was a combination of random sampling and allocated quotas sampling. The idea of using this sampling strategy was not theoretical, but a technical measure to ensure the representativeness of the sociodemographic groups needed. To get a representative sample from both places, a random sample was first drawn. Here the idea of this type of probability sampling is that every unit in the population has a chance (greater than zero) of being selected for the sample, and this probability can be accurately determined. After that quotas were formed on the basis of municipality, gender and age structure. These quotas were needed when the interviewers started work. The program used by the market research company selected the interviewees randomly for the interviewers. At the beginning of the interview, the task of the interviewers was to elicit gender and age to put the interviewee into in the right quota. When there were enough interviews in the different age and gender groups, the program closed the quota and no more interviews could be gathered to that particular quota. Here, the idea was to gather enough interviews in each of the quotas to ensure a representative sample regardless of how

eager the people in these groups might be to participate. We can say that this technique is probability sampling within the quotas. Allocation to the quota was based on the most recent population data available. The marketing research company Tietoykkönen Oy (Jyväskylä, Finland) uses this type of sampling strategy when conducting opinion polls on political party preferences. Both samples were obtained from the Population Register Centre. Telephone numbers were provided by the company Fonecta Oy, Helsinki, Finland. However, people whose telephone numbers were secret (ex-directory) could not be included in the sample. In Pyhäjoki, there were 1274 people in the sample and in Eurajoki and Luvia there were 2001 people in the sample. From those in Pyhäjoki, 462 of the respondents and in Eurajoki and Luvia 768 were contacted in order to get responses from 204 residents in Pyhäjoki and 250 residents from Eurajoki and Luvia (Table 2). The overall response rate was 37%: 43% in Pyhäjoki and in 33% Eurajoki and Luvia (see Table 2). The respondents were also given an opportunity to answer *via* Internet by completing a web-based questionnaire. In Pyhäjoki, 181 interviews were conducted and 23 respondents chose the web-based questionnaire instead of the telephone survey. In Eurajoki and Luvia, 221 interviews were conducted and 29 respondents chose the web-based questionnaire instead of the telephone survey (Table 2). The questionnaire (see Table 3) was the same for those choosing the telephone survey or the web-based survey but it should be noted that the method of a survey may to some extent affect a respondent's understanding of a questionnaire. All 454 responses were eligible for analysis. Community acceptance, perceptions of justice and trust were measured on a 5-point Likert scale inviting responses to certain statements. These were further recoded to a 3-point Likert scale, so that 1–2 are given value 1, 3 is given value 2 and 4–5 are given value 3. We state that 1 equals disagree, 2, neither agree nor disagree and 3 agree. This recoding was done since the sample size is small, and by combining the measures, we could increase the *N* to make more generalized conclusions. Table 3 presents survey items categorized under the main concepts of this study as introduced in Section 2.2. The data were analyzed using SPSS software (SPSS, Chicago, IL).

The statistical representativeness of the population was analyzed by conducting a non-response analysis where the respondent's gender, age, level of education, occupational/socio-economic status, main occupation, political affiliation and were compared to the information obtained from Statistics Finland. The representativeness was good, and the data represents well the population of Eurajoki and Pyhäjoki although some biases were observed. In the Pyhäjoki survey, the age group of those born in the period 1949–1953 is overrepresented by 6%, and in the Eurajoki survey, the age group born in the period 1979–1983 are overrepresented by 6%. When it comes to main type of activity, unemployed people are underrepresented in the Eurajoki survey by 5%. Pensioners are overrepresented both in the Eurajoki (6%) and the Pyhäjoki survey (7%). The lowest income group (under 10,000 euros p.a.) is underrepresented in both the Pyhäjoki (9%) and the Eurajoki (13%) surveys when compared to the average income of the population in Finland. Finally, when it comes to level of education, those who have no qualification after basic education are underrepresented both in Pyhäjoki (11%) and Eurajoki (9%), and those holding polytechnic or university degrees are overrepresented by 8% in the Pyhäjoki survey. Another aspect that can challenge the representativeness of the data concerns were willing to participate in the survey. Since the topic and questions of the survey were challenging for those not already familiar with the topic, it may be that those more involved in nuclear issues were over-represented in the sample of the survey data.

The statistical representation should also be addressed in terms of the size of the sample. As the sample size is small in our study the results should be viewed with caution. Also, the sample size in the Eurajoki survey is larger than that in the Pyhäjoki survey, which is due to the larger population. Mattila (2004) points out that confidence level and confidence interval can be used to analyze the statistical representativeness. The confidence intervals of the percentages studied were max  $\pm$  7 with the confidence level of 0.95. The confidence intervals are higher than in surveys with larger sample size. This is typical for studies with smaller sample sizes. Sample size

also has an effect on the statistical power<sup>2</sup> and low power increases the chance of missing a difference between groups when a difference truly exists (McClure 1998). In a few measures (see Chapter 5.1), the statistical power was less than 0.8, which is the desired level for power. The methods used to analyze the data are mainly descriptive. We apply the independent sample t-test to compare means between perceptions of justice and trust in both communities. Overall, we found that the differences between mean values of the groups were (mostly) small. The purpose of the correlation analysis is to give indications of which aspects of justice and trust are related to community acceptance. The results from the correlation analysis should be addressed only as linear relationship between the two variables.<sup>3</sup> To learn more about the causality between them is a topic for further studies. Here, we take it that correlations over 0.200 are strong and correlations over 0.150 are weak but significant. This is a generally accepted value in social scientific research (Jokivuori and Hietala 2007). The study results should be understood as preliminary and descriptive. We used an alpha level of 0.05 for all statistical tests.

## 5. Results

### 5.1. Conceptions of justice in two nuclear communities

We studied the perceptions of justice and trust among residents in two nuclear communities, i.e. one nuclear oasis (Eurajoki) and one greenfield community (Pyhäjoki) regarding the siting of Fennovoima's SNF repository (Figures 2 and 3).

It emerged that the nuclear communities expressed concern over procedural and distributive justice. Half of the respondents from the nuclear oasis and around 40% of the greenfield community perceived that the information provided about siting the second repository in Finland and its possible alternatives was not sufficient. Another indication of perceived injustice regarding procedures was the finding that around 40% in both communities agreed that the decision-making regarding the repository siting did not give enough voice to the disadvantaged in society. Also, we found that 60% of the respondents in the nuclear oasis and about half of the respondents in the greenfield community agreed that there should be an advisory municipal referendum. This shows that the respondents perceived that the views of lay people and community members should be included in decision-making. As noted in Section 3, in Finland no such referenda have previously been held. When the mean values of the procedural justice measures were compared between the communities (Table 4) we found that on a 3-point scale the respondents from the nuclear oasis ( $M = 1.79$ ,  $SD = 0.854$ ) had a slightly poorer opinion of information dissemination than did the greenfield community ( $M = 1.98$ ,  $SD = 0.889$ ) and ( $t(443) = -2.235$ ,  $p = .026$ ).<sup>4</sup> When it comes to other aspects of procedural justice no significant differences between the groups were found.<sup>5</sup> The slight difference between the communities in perceived information dissemination may suggest greater experienced injustice regarding the siting process in the nuclear oasis than in the greenfield community, at least in the case of the new project related to nuclear waste siting.<sup>6</sup> This finding should be understood in the context of the relationship with the nuclear industry, and more precisely with Fennovoima. The nuclear oasis is not familiar with the new actor in the NWM field, although it has experience of siting procedures with other actors in the field.

Examination of the distributive justice perceptions showed that about 60% of the respondents in the greenfield community and half of those in the nuclear oasis agreed that the benefits and risks of nuclear waste disposal of the second repository were unequally shared in society. The share of benefits in one's home municipality was perceived to be fair, with around 15% of the respondents in the nuclear oasis and the greenfield community perceiving injustice. The results of comparing mean values on a 3-point scale (Table 4) revealed that between the groups, respondents in the greenfield community ( $M = 2.42$ ,  $SD = 0.81$ ) did find the distribution of risks and benefits more unjust than did the respondents in the nuclear oasis ( $M = 2.17$ ,  $SD = 0.87$ ). The difference

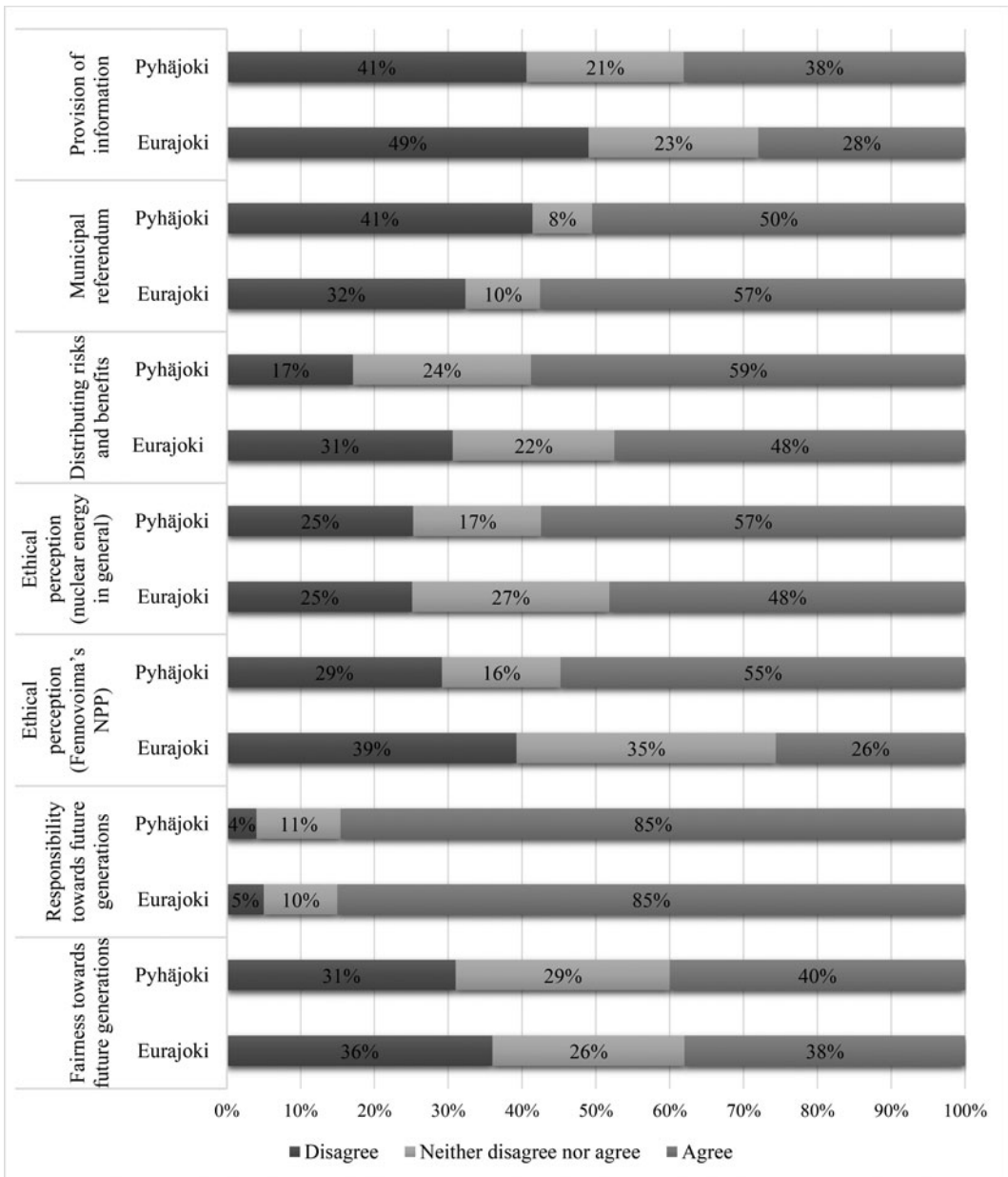


Figure 2. Perceived justice in matters pertaining to NWM.

between the mean values is small, although statistically significant ( $t(439) = -3.177, p = .002$ ). Intergenerational injustice as well as justice was experienced in both communities; 38% in Eurajoki and 40% of the respondents in Pyhäjoki agreed that the SNF siting was not a fair solution thinking of future generations; however, we also found that in Eurajoki there are almost similar amount of those who disagree (36%) while in Pyhäjoki this amount is less (31%). This indicates that there are some differences, although the differences between the mean values are not statistically significant ( $t(441) = -0.961, p = .808$ ). Meanwhile, 85% of residents in both communities agreed that it was the responsibility of the present generation to make the decision about the geological disposal of SNF. There were no statistically significant differences between groups ( $t(449) = -0.042, p = .869$ ).<sup>7</sup>

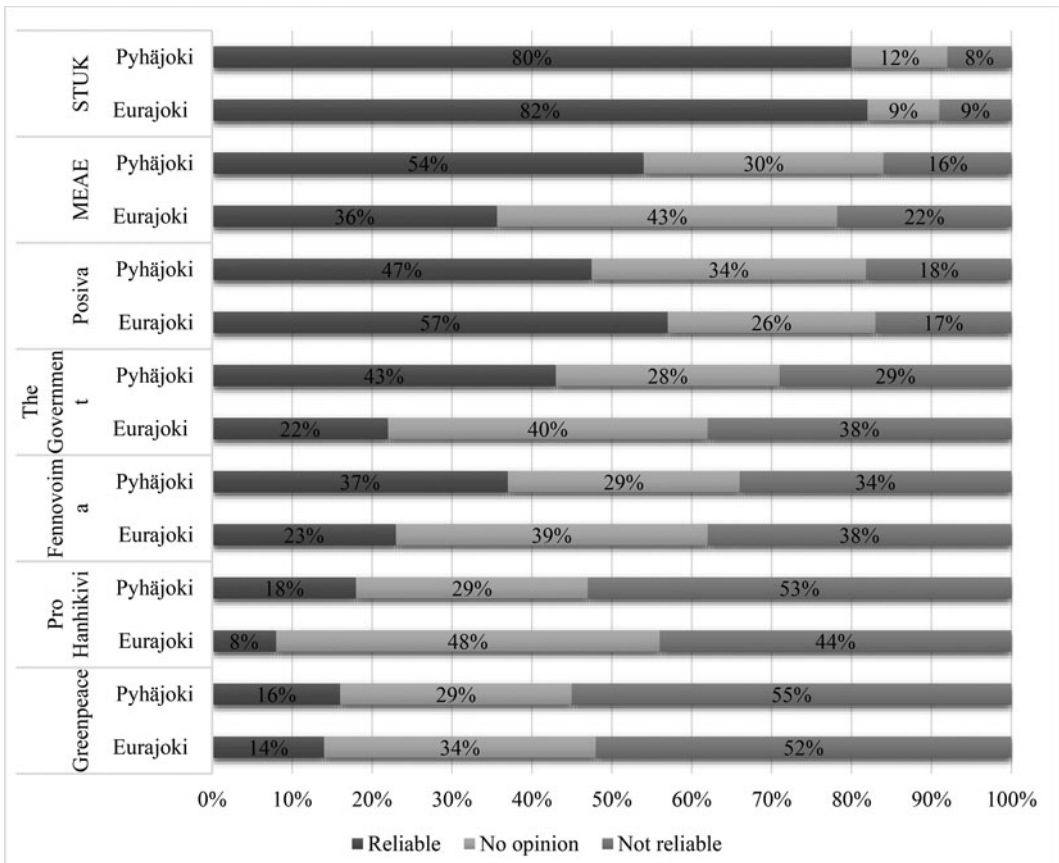


Figure 3. Trust in actors in matters pertaining to NWM.

Table 2. Use of the original sample in the survey, when the target was to conduct 200 interviews in Pyhäjoki and 250 interviews in Eurajoki and Luvia, and response rate in relation to people contacted.

	Pyhäjoki	Eurajoki (incl. Luvia)	Total
Number of people contacted	462	768	1230
Number of declined people, when contacted	262 (247 phone + 15 web)	518 (486 phone + 32 web)	776 (728 phone + 48 web)
Response rate (%) in relation to people contacted	43.3	32.5	36.6
Number of telephone interviews (n)	181	221	402
Number of web-questionnaire respondents (n)	23	29	52
Data (n)	204	250	454

We studied ethical attitudes to nuclear energy. Only one-fourth of the respondents in the nuclear oasis agreed that Fennovoima’s planned NPP in Pyhäjoki was ethically legitimate, whereas in the greenfield community the majority (55%) of the respondents perceived the NPP as ethically legitimate. However, the perceived justice regarding nuclear energy in general produced more similar results as around 60% of the respondents in the greenfield community and half of the respondents in the nuclear oasis agreed that nuclear energy was ethically justified. When the differences of means were compared on a 3-point scale, we found that while the difference between groups was not significant when it came to nuclear power in general ( $t(447) = -1.145, p = .26$ ), the respondents in the greenfield community ( $M = 2.26, SD = 0.88$ )

**Table 3.** Main terms of the study and questionnaire items.

Term	Questionnaire item
Community acceptance	The spent nuclear fuel from the Fennovoima nuclear power plant should be finally disposed of in Eurajoki/Pyhäjoki
Distributive justice	–
Distributing risks and benefits	It is wrong that the greatest environmental risk regarding the final disposal of Fennovoima's nuclear waste should be borne by the population living in the immediate vicinity, when most of the electricity produced is consumed by people and industrial concerns a long way from the plant
Fairness of benefits	Only the well-off people in my home municipality benefit from the final disposal of nuclear waste
Procedural justice	–
Provision of information	The information provided on the final disposal of Fennovoima's nuclear waste and the possible alternatives has been sufficient
Discrimination	The views of the disadvantaged are not taken sufficiently into account when deciding on the final disposal site for Fennovoima's nuclear waste
Municipal referendum	An advisory referendum should be held in the next few years in my home municipality on the site of the final disposal of Fennovoima's nuclear waste
Intergenerational justice	–
Fairness toward future generations	Disposing of nuclear waste into the bedrock is not a fair solution thinking of future generations
Responsibility toward future generations	It is the duty of the present generation to decide on the final disposal of nuclear waste and not to shift the responsibility onto future generations
Trust	To what extent do you consider the following actors morally reliable in matters pertaining to nuclear waste management?
Ethical attitude toward nuclear energy	–
Fennovoima's NPP	The implementation of the Fennovoima nuclear power plant project is ethically justified
Nuclear energy in general	The production of electricity with nuclear energy is ethically justified

perceived the NPP initiated by Fennovoima to be more ethically legitimate than did the respondents in the nuclear oasis ( $M = 1.86$ ,  $SD = 0.80$ ) and ( $t(403) = -4.862$ ,  $p = .000$ ). Here, it should be noted that the greenfield community of Pyhäjoki will be also the host for Fennovoima's plant. Therefore, the residents in the greenfield community had an opportunity to participate in the decision-making. Also, they will stand to gain economically from the NPP unlike those living in the nuclear oasis. Compared to the greenfield site, the role of the nuclear oasis will be to bear the possible risks and end up as the dumping place for the SNF from Fennovoima's planned NPP. However, the belief in the ethical legitimacy of nuclear energy in general was surprisingly low in the nuclear oasis, which has hosted the industry for decades.

Respondents' trust as regards the moral reliability of the main actors of NWM was studied (see Figure 3). Among the main actors analyzed in the study, the Finnish Radiation and Nuclear Safety Authority (STUK) was perceived as the most reliable according to the responses of nearly 80% in both communities.<sup>8</sup> In the greenfield community over half (54%) perceived the Finnish Ministry of Economic Affairs and Employment (MEAE) and 43% perceived the Government of Finland as morally reliable. In the nuclear oasis about one-third (36%) of respondents perceived the MEAE and around one fifth (22%) perceived the Government as morally reliable. About one-third (37%) of the respondents in the greenfield community and one fourth (23%) in the nuclear oasis perceived Fennovoima to be morally reliable. The NGOs Greenpeace and the local anti-nuclear group Pro Hanhikivi were found the most unreliable in both communities. When the means between communities were compared (see Table 5), we found that the respondents in the greenfield community placed more trust in the Government of Finland ( $M = 2.15$ ,  $SD = 0.84$ ),  $t(403.5) = -4.038$ ,  $p = .000$ , MEAE ( $M = 2.39$ ,  $SD = 0.74$ ),  $t(438) = -3.42$ ,  $p = .001$  and Fennovoima



**Table 4.** Differences in mean values (Likert scale 1–3, 1 = disagree and 3 = agree) of the survey items of perceptions of justice.

		Eurajoki	Pyhäjoki
Procedural justice			
Provision of information	<i>M</i>	1.79	1.98
	<i>SD</i>	0.854	0.889
	<i>t</i>	$t(443) = -2.235, p = .026$ 2-tailed	
Discrimination	<i>M</i>	2.16	2.18
	<i>SD</i>	0.772	0.814
	<i>t</i>	$t(425) = -0.221, p = .825$ 2-tailed	
Municipal referendum	<i>M</i>	2.25	2.11
	<i>SD</i>	0.914	0.953
	<i>t</i>	$t(447) = 1.673, p = .097$ 2-tailed	
Distributive justice			
Distributing risks and benefits	<i>M</i>	2.17	2.42
	<i>SD</i>	0.87	0.81
	<i>t</i>	$t(439) = -3.177, p = .002$ 2-tailed	
Share of benefits	<i>M</i>	1.57	1.60
	<i>SD</i>	0.71	0.49
	<i>t</i>	$t(430) = -0.465, p = .709$ 2-tailed	
Intergenerational justice			
Fairness toward future generations	<i>M</i>	2.02	2.09
	<i>SD</i>	0.86	0.84
	<i>t</i>	$t(441) = -0.961, p = .808$ 2-tailed	
Responsibility toward future generations	<i>M</i>	2.80	2.81
	<i>SD</i>	0.50	0.49
	<i>t</i>	$t(449) = -0.042, p = .869$ 2-tailed	
Ethical perceptions toward nuclear energy			
Nuclear energy in general	<i>M</i>	2.23	2.32
	<i>SD</i>	0.82	0.85
	<i>t</i>	$t(447) = -1.145, p = .260$ 2-tailed	
Fennovoima's NPP	<i>M</i>	1.86	2.26
	<i>SD</i>	0.80	0.88
	<i>t</i>	$t(403.3) = -4.862, p = .000$ 2-tailed	

The questionnaire items are presented in Table 3.

**Table 5.** Differences in mean values (Likert scale 1–3, 1 = unreliable and 3 = reliable) of trust in the main actors in nuclear waste management.

Actor		Eurajoki	Pyhäjoki
Finnish Radiation and Nuclear Safety Authority (STUK)	<i>M</i>	2.73	2.72
	<i>SD</i>	0.61	0.60
	<i>t</i>	$t(442) = 0.136, p = .892$ 2-tailed	
Posiva	<i>M</i>	2.40	2.29
	<i>SD</i>	0.76	0.76
	<i>t</i>	$t(423) = 1.545, p = .123$ 2-tailed	
Finnish Association for Nature Conservation (FANC)	<i>M</i>	2.20	2.03
	<i>SD</i>	0.75	0.78
	<i>t</i>	$t(432) = 2.372, p = .018$ 2-tailed	
Ministry of Economic Affairs and Employment (MEAE)	<i>M</i>	2.14	2.39
	<i>SD</i>	0.74	0.74
	<i>t</i>	$t(438) = -3.416, p = .001$ 2-tailed	
Fennovoima	<i>M</i>	1.85	2.03
	<i>SD</i>	0.77	0.84
	<i>t</i>	$t(432) = -2.312, p = .021$ 2-tailed	
Government of Finland	<i>M</i>	1.84	2.15
	<i>SD</i>	0.76	0.84
	<i>t</i>	$t(404) = -4.038, p = .000$ 2-tailed	
A local anti-nuclear group Pro Hanhikivi	<i>M</i>	1.64	1.66
	<i>SD</i>	0.62	0.77
	<i>t</i>	$t(374) = -0.265, p = .791$ 2-tailed	
Greenpeace	<i>M</i>	1.62	1.60
	<i>SD</i>	0.72	0.75
	<i>t</i>	$t(429) = 0.28, p = .779$ 2-tailed	

**Table 6.** Acceptance of Fennovoima's SNF repository in respondents own municipality by gender (%).

	Pyhäjoki			Eurajoki		
	Gender		All N = 200	Gender		All N = 249
	Men N = 103	Women N = 97		Men N = 127	Women N = 122	
Agree	20	6	14	24	9	17
Neither disagree nor agree	25	12	19	18	21	20
Disagree	54	81	68	58	70	64

**Table 7.** Correlation coefficients between acceptance of the Fennovoima repository in respondent's own municipality and perceptions of justice,  $r$ =negative statements recoded as positive.

	Eurajoki	Pyhäjoki
Procedural justice		
Provision of information	.380***	.323***
Discrimination ( $r$ )	.172**	.336***
Municipal advisory referendum	-.305***	-.375***
Intragenerational distributive justice		
Distributing risks and benefits ( $r$ )	.262***	.528***
Fairness of benefits ( $r$ )	-0.007	.235***
Intergenerational justice		
Fairness toward future generations ( $r$ )	.276***	.300***
Responsibility	-0.002	-0.076
Ethical perceptions toward nuclear energy		
Nuclear energy in general	.183**	.428***
Fennovoima NPP	.373***	.436***

\*\*\* $p < .001$ , \*\* $p < .01$

**Table 8.** Correlation Coefficient: Community acceptance and trust in the main actors.

Actor	Eurajoki	Pyhäjoki
Fennovoima	.357***	.345***
Finnish Radiation and Nuclear Safety Authority (STUK)	0.101	.150*
Posiva	.175**	.268***
Government of Finland	0.120	.258***
Ministry of Economic Affairs and Employment (MEAE)	.230***	.207**
Greenpeace	0.085	.217**
Finnish Association for Nature Conservation (FANC)	0.024	.197**
A local anti-nuclear group Pro Hanhikivi	-0.017	-.296***

\*\*\* $p < .001$ , \*\* $p < .01$  and \* $p < .05$ .

( $M = 2.03$ ,  $SD = 0.84$ ),  $t(432) = -2.31$ ,  $p = .021$ ,<sup>9</sup> than did those in the nuclear oasis. Lower institutional mistrust and mistrust in the company in the nuclear oasis may indicate a greater sense of procedural (or political) injustice as regards the role of Eurajoki in Fennovoima's site selection process than there was in the greenfield community.<sup>10</sup>

## 5.2. Local acceptance of the SNF disposal facility as an ethical issue

The relation between community acceptance and ethical issues surrounding SNF disposal was studied (Tables 6–8). Community acceptance of the planned Fennovoima SNF repository was elicited with a statement 'The spent nuclear fuel from the Fennovoima NPP should be finally disposed of in Eurajoki/Pyhäjoki' depending on the respondent's home community. According to the survey results, the repository was not accepted either in the nuclear oasis Eurajoki or in the greenfield community Pyhäjoki (Table 6). In the greenfield community 68%, of the respondents and in the nuclear oasis 64% and of the respondents opposed the repository. In the nuclear oasis, men (24%) accepted the repository more often than women (9%), and in the greenfield

community men (20%) accepted the repository more often than women (6%). The non-acceptance of the repository in Eurajoki is not very surprising. In 2008, 62% of the residents of Eurajoki opposed with the extension of the first SNF facility initiated by Posiva for the needs of other Finnish actors (Litmanen, Kojo, and Kari 2010; Kojo, Kari, and Litmanen 2012).

The relation between community acceptance and justice perceptions and trust was studied with correlation analysis. The results of the correlation analysis indicate that in both communities (Tables 7 and 8) most of the statements measuring ethical aspects and trust correlate with community acceptance, which is in line with the conceptual framework of Wüstenhagen, Wolsink, and Bürer (2007) and also of other studies conducted on the subject (i.e. Sjöberg and Drottz-Sjöberg 2001; Krütli et al. 2015).

These results show that procedural factors have a connection to community acceptance. In both communities willingness to hold a municipal referendum correlated highly significantly and negatively (Eurajoki:  $r_s = -0.305$ ,  $p < .001$ , Pyhäjoki:  $r_s = -0.375$ ,  $p < .001$ ). The result can be to some extent understood as indicative of political powerlessness as it indicates that the more positive opinion toward voting, the less the repository is accepted, however, a possible causal effect should be further studied. We found a strong, positive correlation between information provision and acceptance in both communities (Eurajoki:  $r_s = 0.380$ ,  $p < .001$ , Pyhäjoki:  $r_s = 0.323$ ,  $p < .001$ ) which suggests that procedural injustice had bearing on opposing the repository. This finding gives reason to suspect the importance of a sense of procedural and political justice in decision-making on NWM.

We found that in Eurajoki there were strong positive correlations between community acceptance and trust in Fennovoima ( $r_s = 0.357$ ,  $p < .001$ ), and MEAE ( $r_s = 0.230$ ,  $p < .001$ ) and weak positive correlation of trust in Posiva ( $r_s = 0.175$ ,  $p < .01$ ). Also, in Pyhäjoki, there was a strong positive correlation between community acceptance and trust in Fennovoima ( $r_s = 0.345$ ,  $p < .001$ ). This finding is stressing the need for further study as to whether trust in the implementer (here Fennovoima) is influencing acceptance similarly in the nuclear oasis and greenfield site. In the greenfield community, there were also strong positive correlations between community acceptance and trust in Posiva ( $r_s = 0.268$ ,  $p < .001$ ) and the Government ( $r_s = 0.258$ ,  $p < .001$ ), and weak significant positive correlation in trust in MAEA ( $r_s = 0.207$ ,  $p < .01$ ). It should be noted that in the greenfield community trust in all of the main actors correlated with community acceptance, whereas in the nuclear oasis community acceptance and trust in the government, the safety regulator STUK and environmental NGOs did not have statistically significant correlations.

It was found that positive attitude to distributive justice correlated positively with community acceptance, and in the greenfield community, this had a more strongly positive correlation with acceptance ( $r_s = 0.528$ ,  $p < .001$ ) than in the nuclear oasis ( $r_s = 0.262$ ,  $p < .001$ ). In the nuclear oasis, features other than equality in sharing risks and benefits related to Fennovoima's SNF repository siting may have influenced community acceptance more. In the previous section, it was reported that a clear majority of residents perceived that it was the responsibility of the present generation to dispose of SNF. However, this item did not correlate statistically significantly with acceptance of the repository in either community. However, there was a significant positive correlation between fairness toward future generations and community acceptance in both communities (Eurajoki:  $r_s = 0.276$ ,  $p < .001$ , Pyhäjoki:  $r_s = 0.300$ ,  $p < .001$ ). Therefore, intergenerational justice is a factor with at least some impact on community acceptance in nuclear communities.

It was found that positive attitude toward the ethical legitimacy of nuclear energy (Eurajoki:  $r_s = 1.83$ ,  $p < .01$ , Pyhäjoki:  $r_s = 0.428$ ,  $p < .001$ ) and Fennovoima's NPP (Eurajoki:  $r_s = 0.373$ ,  $p < .001$ , Pyhäjoki:  $r_s = 0.436$ ,  $p < .001$ ) correlated significantly and positively with community acceptance in both communities. The correlation coefficients were positive indicating that moral acceptance of nuclear energy may have a positive impact on acceptance of SNF disposal. This result demonstrates how the morality of nuclear energy is connected to acceptance of an SNF repository in nuclear communities. To conclude, in general the correlations were positive,<sup>11</sup> indicating that in nuclear communities the more positive the view of community acceptance of the

repository, the more justice was perceived in the procedures and outcomes of SNF disposal, and the more the actors were trusted in NWM issues. However, to study whether such a causal effect exists the issues should be studied with a different data set. To emphasize the differences between the communities, it was a noteworthy pattern that the correlation coefficients were more significant in the greenfield community than in the nuclear oasis.

## 6. Discussion

This article contributes to several ongoing discussions in the field of NWM research. First of all, it contributes to specifying the ethical dimensions of the NWM; i.e. while international organizations, such as the IAEA and the OECD-NEA have developed several ethical principles regarding the NWM, these have often remained abstract and undefined and hence sometimes useless in the practice of NWM. The empirical research on ethical issues is on the increase (see e.g. Krütli et al. 2012, 2015; Huang, Gray, and Bell 2013; Seidl et al. 2013; Ocelik et al. 2017; Stefanelli, Seidl, and Siegrist 2017; Cotton 2018). Studies, such as this help to put empirical flesh on the theoretical bones of such principles. For instance, our study advances the understanding of host communities by providing insights into the development stages of 'nuclear communities' in terms of residents' perceptions of justice and trust. Blowers (2016) has outlined two stages of such communities but his empirical approach does not provide information regarding local opinions. Di Nucci and Brunnengraber (2017) studied different forms of voluntarism in combination with various site typologies. In their taxonomy of host communities, Di Nucci and Brunnengraber (2017) ask 'what are the specific characteristics of the host communities prone to accept such incentives?' Our comparative approach between the two development stages in the context of a high-trust society indicates that there are differences between the stages, i.e. two potential host communities. Our findings could help to further theorize the development process of a nuclear community.

This article also sheds light on local opinions concerning nuclear new build and the extension of final disposal capacity. This is important as the projections of nuclear energy worldwide have not changed substantially, not even after the Fukushima Daiichi accidents (Taebi and Roeser 2015, 2). However, the separation between the already existing waste and the waste which would be produced due to new build or a 'nuclear renaissance' is a particularly hot issue from the viewpoint of nuclear ethics (Blowers 2016, 95; Cotton 2017, 223–226). Existing SNF and other radioactive waste must be managed safely but should it be allowed to produce more waste? While our analysis does not deal with the thorny question of the 'desirability of nuclear energy', it does shed light on the issue of siting a possible second repository and responses to that in different nuclear communities. In this sense, Eurajoki as a nuclear oasis is a unique case study. The local council of Eurajoki has already approved the extension of the Posiva repository three times, yet the residents are still reluctant to accept the final disposal of SNF produced by the power company Fennovoima, which is less familiar and not so well established in the community. On the other hand, Pyhäjoki as a Greenfield site approved after a vote on the location of a new NPP unit in its territory is now reluctant to accept a repository for SNF. In both communities, respondents have similar concerns about intergenerational justice, but perhaps the difference (regarding trust and justice issues) between the stages in one country are more interesting outside the Finnish context. These findings suggest that in terms of policy design international organizations and nuclear industry should acknowledge ethical diversities<sup>12</sup> at local level and consider their evaluations and assessments more seriously from the viewpoint of ethics. For instance, Cotton (2018) speaks for a voluntary-participatory decision-making process or a partnership model which has the in-built capacity 'to simultaneously scale up local community concerns, and scale down national concerns ... to a level whereby both can be effectively balanced such that meaningful, low-conflict political dialogue can occur.' According to Cotton rebalancing, local, regional and national scales of interest could ameliorate or resolve environmental injustices.

The results regarding the nuclear oasis also emphasize the importance of continuity in the fairness of a siting process. Earlier Krütli et al. (2015, 136) noted the violations of procedural aspects and ‘long memory’ in the Wallenberg case. The results of our survey indicate that trust in government is indeed weaker among the residents of a nuclear oasis compared to a greenfield site. In the case of Eurajoki, this can be interpreted as a community level response to a rather coercive discourse used by some of the ministers responsible in a debate on Posiva-Fennovoima dispute on the joint final disposal of SNF at Olkiluoto site (Kojo and Oksa 2014).

This study was conducted in a so-called high-trust country, which is characterized by strong trust in institutions, such as public administration, legal system, army, police, regional and local authorities and even in government, parliament and political parties, at least to some degree (see e.g. Eurobarometer 2017, 44–54; 2018). However, as we have shown in our study, under certain conditions of general societal trust there can be differences in trust at the localities.

Even if there were agreement on the societal need for a certain project – as is the case when it comes to NWM in Finland – there could be serious differences at the local level that need to be acknowledged. Our analysis helps to provide a lens to zoom in on the ethical issues that play an important role at the local level, instead of discussing ethics in an abstract and intangible way at the level of national or sometimes international policy-making. Thus, we assume that our results on trust could be transposed to other cultural contexts than high-trust societies.

In general, we can say that our survey took place within the realm of acceptability and accorded a higher level of relevance to ethical issues than is the case in ‘conventional’ acceptance studies. In that respect, it responds to the need to put empirical flesh on the conceptual bones of ethical analysis (Taebi 2017).

## 7. Conclusions

The purpose of this study was to compare ethical perceptions of a possible second SNF repository in Finland initiated by the new power company, namely Fennovoima, due to the government’s requirements in two municipalities, which are in different developmental stages as nuclear communities. We investigated whether perceptions of justice and trust varied between the two communities. We further investigated the relation of ethical issues and local acceptance with a correlation analysis. It was found that the nuclear oasis would not tolerate the siting of Fennovoima’s repository more readily than the greenfield community. Therefore, our study results do not entirely support Blowers’ thesis on a ‘culture of acceptance’ in nuclear oases. However, it is suggested ‘culture of acceptance’ is a more broad and abstract issue than simply a question of community acceptance.

The key findings revealed similarities and differences between the nuclear oasis and the greenfield site in ethical perceptions of final disposal of SNF. The main differences included that procedural justice and distrust were emphasized more in the nuclear oasis, while in the greenfield community intragenerational distributive injustice was emphasized to be found more when the communities were compared to one another. Surprisingly, intergenerational justice was perceived similarly in both communities, suggesting that no particular understanding toward future generations had developed over the decades despite all information dissemination efforts in the nuclear oasis (Kojo 2002; Hänninen and Yli-Kauhaluoma 2015). Also, when the communities were compared, we found that the establishment of Fennovoima’s NPP in Pyhäjoki was perceived to be less ethically legitimate in the nuclear oasis. However, both communities perceived similarly the ethical legitimacy of nuclear energy. This indicates that the nuclear oasis did not show more support for nuclear power than did the greenfield community. This may indicate that there is a culture of acceptance toward nuclear energy within Finnish society.

We claim that these Finnish nuclear communities perceive environmental, political and social injustice regarding the Fennovoima SNF repository siting. Therefore, the findings of our study concur with those of earlier studies on the fairness of NWM (Sjöberg and Drottz-Sjöberg 2001;

Krütli et al. 2012; Huang, Gray, and Bell 2013; Ocelik et al. 2017). In addition, our results support the findings of Huang, Gray, and Bell (2013), Gowda and Easterling (2000) and Fan (2006), who found that the residents of communities subject to nuclear waste disposal perceived an instance of intergenerational injustice related to nuclear waste disposal (i.e. it is a transferred risk to future generations) and intragenerational injustice. We argue that the community's wishes should be considered earlier in the planning of an extension to support a fair siting process and to avoid causing perceptions of injustice and mistrust. Acceptance should not be taken for granted, not even when it comes to nuclear oases.

The findings of our study support those of earlier studies (Krütli et al. 2015, 2012) since we suggest that both procedural and distributive justice are influential in the acceptance of nuclear waste disposal. We found that even though injustice and mistrust were perceived in both nuclear communities, they were more strongly related to the acceptance in the greenfield community. This may indicate that more idealistic views in the greenfield community were present, whereas the nuclear oasis had already faced the reality and ethical trade-offs related to SNF management which be seen an indication of a 'culture of acceptance'. This should be a subject to further studies.

Although the political decision on the final disposal of SNF was made nearly two decades ago and the first licensed repository for SNF is already under construction, the results suggest that fairness to future generations is a relevant issue for a forerunner country within the NWM. As we argued earlier, the connection between intragenerational and intergenerational justice has received little attention in the literature. The Finnish case and the comparative analysis of two nuclear communities shed light on this matter. We found how intragenerational justice, in the sense of unequal distribution of the benefits of nuclear power (Fennovoima NPP) and the risks of nuclear waste disposal, was found to be more influential in the greenfield site (i.e. Pyhäjoki) than in the nuclear oasis (i.e. Eurajoki). However, when the communities were compared, there was no difference when it came to perceptions of intergenerational justice. Therefore, we surmise that the culture of acceptance in the nuclear oasis may strengthen perceptions of *intra*generational distributive justice without exerting a similar effect on *inter*generational justice. The results emphasize that more attention should be paid to how intergenerational *versus* intragenerational justice concepts are operationalized in isolation but also with regard to each other, and whether the focus is on decision-making or the outcomes and risks for present, near or distant generations (see also, e.g. Ocelik et al. 2017; Seidl et al. 2013).

Regarding moral trust in the main actors in the Finnish nuclear waste regime, we found that Eurajoki as a nuclear oasis posed greater distrust in the government and the Finnish MEAE, i.e. the responsible ministry, as well as in Fennovoima. We surmise that the nuclear oasis was suspicious due to the minor role given to the municipality in the planning of the Fennovoima SNF management, particularly concerning possible joint national disposal at the Olkiluoto site, which is not based on a voluntary approach (see Kojo and Oksa 2014). Moreover, from the late 1970s to the late 1990s, the municipality had wrestled with the nuclear waste issue. The struggle was characterized by voting, political pressure, compensation negotiations and fears of state intervention (Kojo 2009, 174–185), which has surely gained some experiences regarding the role of a nuclear oasis (see also Krütli et al. (2015, 136) on 'long memory' in procedural violations). We studied trust here separately from procedural justice since in our theoretical concept community acceptance makes a distinction between trust, procedural justice and distributive justice. However, trust can also be understood as a dimension of procedural justice. We conclude that to build community acceptance in new high-risk projects, trust in the implementer is key. However, we see that this is not sufficient criteria for acceptance. Future research should be carried out on how trust can be built between the NWM company and the nuclear community in relation to their earlier procedural violations, and how these trust issues may occur in questions of ethics in nuclear communities.

The planning of the second repository is at a very early stage and, therefore, there is no certainty whether the residents' opinions that the siting of the repository is not accepted will turn into political resistance. So far in the nuclear oasis, there are not many signs of such political action. It may

be too early to predict whether a culture of acceptance or 'nuclear culture' will evolve in the future as the planning of the repository will go further. The nuclear oasis is now unsure and reserved because the planning and site selection process of the possible second SNF repository in Finland was initiated without community consent violating the ethical perceptions in the community.

## Notes

1. Multinational repositories could be beneficial from the point of view of justice to future generations, while they give rise to various instances of intragenerational injustice. For an extended defence of this argument (see Taebi 2012b).
2. The correlation coefficients must be viewed with caution since the variables measuring community acceptance are skewed and the sample sizes are small.
3. The difference between groups is  $p < .05^*$
4. The municipal referendum item had statistical power  $\beta = 0.35$ , so there is a 35% likelihood of missing the difference between groups when it truly exists (thereby causing a type II error), with power  $(1 - \beta)$  set at 0.80,  $\alpha = 0.05$ , two-tailed.
5. Regarding information provision, it should be noted that the Environmental Impact Assessment procedure started in 2016, while the public debate about the Fennovoima's SNF management has been going on since the establishment of the company.
6. It should be noted that in the questionnaire the formulation of the claim might to some extent explain these very high figures.
7. This in line with the high trust of Finns in societal institutions and science (Kiljunen 2016, 35–37). Finns, like the people in the Nordic countries, also have a fairly positive orientation toward the government (Melin 2009, 72–73).
8. Please note that the difference between the means is small ( $p < .05^*$ ).
9. For instance, the municipality of Eurajoki has warned that the state should not take any coercive decisions in the issue and that the rights of the municipality should not be violated (Kojo and Oksa 2014, 20, 25).
10. Please note that negative questionnaire items are recoded here as positive.
11. In other energy related areas the relevance of acknowledging ethical diversity – also referred to as normative diversity has been emphasized; see (Cuppen et al. 2016).
12. Source: Sipola (2017).

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