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Navigating the Future of Energy in Norway

Regulatory, Procedural, and Transparency Challenges in Nuclear Power Implementation

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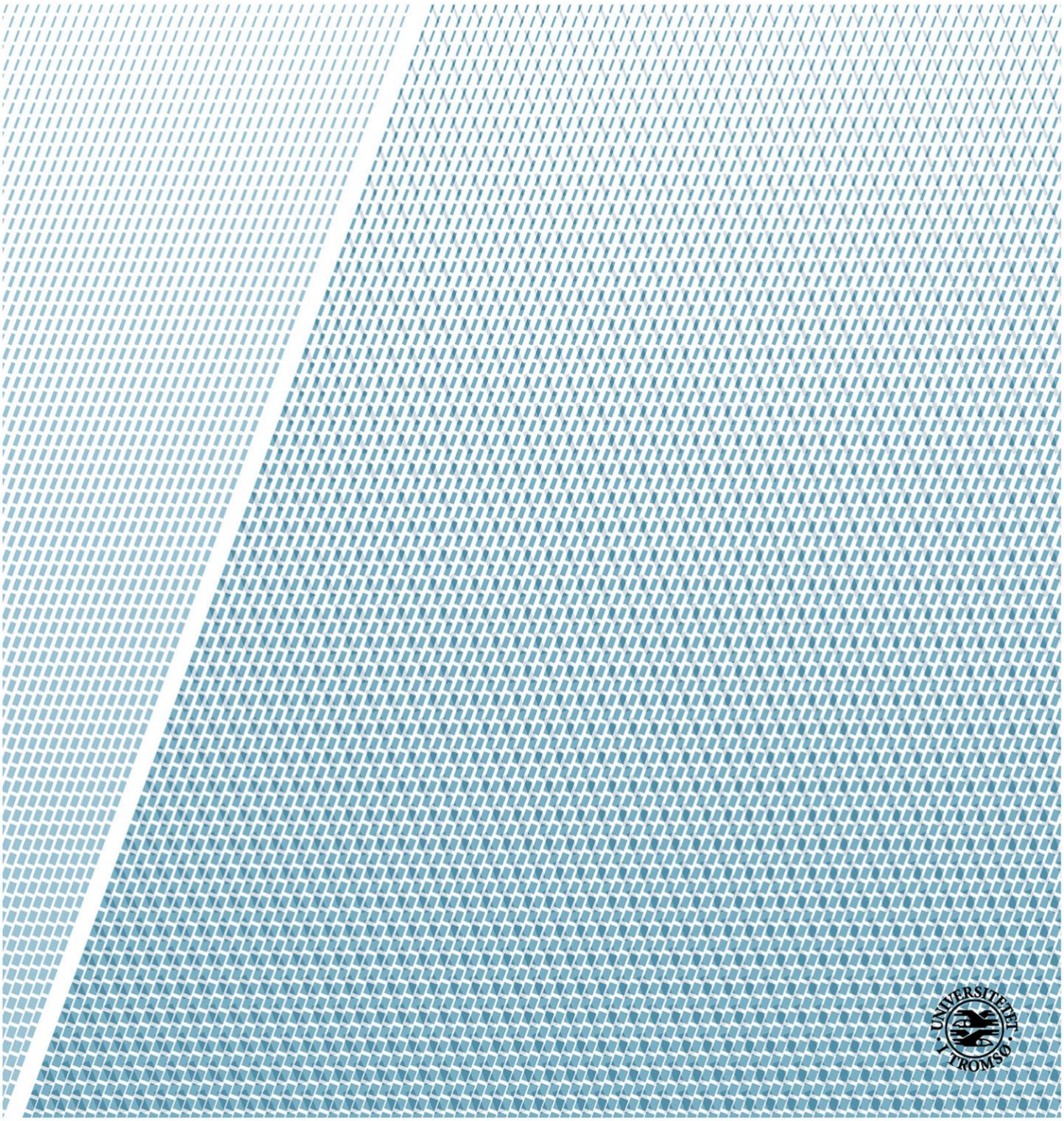

Abstract

Norway is in the crossroads of an energy transition, while it is in need for extensive power production to not reach a power deficit in the coming years. War in Europe, decommissioning the petroleum sector, and investing in green energy sources, comes with a price. Energy projects are conflict-ridden, and many local communities experience decreased acceptance for new technologies. This study looks at what procedures and regulations are present in Norway, how they can be used in the nuclear sector, and how justice is ensured in the processes used to implement energy technologies. I answer the problem statement: *How can Norway ensure a legitimate and transparent process with regards to the implementation of nuclear power, with the goal of enhancing the energy security?*

The study is based on eight semi-structured interviews with informants from the public and private sector, in addition to a literature review of relevant articles. The study's conclusion is that Norway has many of the regulations that are needed, but that they need revision and to be better incorporated in the legal framework. Additionally, the regulatory body needs strengthening, in the form of increased competency and more personnel. There is currently not a political green light for nuclear power in Norway, which seems to be the biggest obstacle as of now. Further, Norway needs to better their practices when it comes to inclusion and local acceptance, which is currently lacking.

Acknowledgements

This thesis concludes my five years as a university student, with the years spent across Norway at different universities. These last two years at UiT- the Arctic University in Norway have been educational, challenging, and amusing, and it ends with this thesis. It is a bitter-sweet feeling finishing my thesis, but summer holiday has never been more motivating.

Thank you, Associate Professor Masoud Naseri, for being my supervisor. Several people have helped me in this process, and they all deserve a medal for their contributions. I thank my closest family, mom, dad, uncle, aunt, and everyone who has contributed to keep my sanity and read through my work.

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Lastly, I want to thank myself. Life has not been easy, but I've persevered.

Oda Rønning Vikan

Stjørdal, May 31st 2024

Nomenclature

EIP: Energy infrastructure projects

LCOE: Levelized Cost of Energy

NIMBY: Not-In-My-Backyard

NP: Nuclear power

NPP: Nuclear power plant

RE: Renewable energy

SMR: Small modular reactor

VRE: Variable renewable energy

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1 Introduction

1.1 Background and relevance

Energy security has been debated for decades, and it is an important part of a country's national security and preparedness. Russia's invasion of Ukraine and the following electricity crisis showed the importance of securing each country's security of supply, and that being dependent on imports from authoritarian countries can provide problems of its own. The Norwegian government has given different mandates to several committees and working groups (NOU 2023:3, NOU 2023:17, Energi21), to see if they can find where Norway needs to focus its work in the future. Most relevant is the Energy Commission (NOU 2023:3), who looked at the whole energy system and surrounding aspects and found that there is an expected increase in power usage that exceeds the current production (NOU 2023:3, p. 74).

This expectation is based on calculated population growth, the transition from fossil fuel to electrification in the transport sector, and the industrial growth (NOU 2023:3, p. 74). The Energy Commission further notes that Norway has climate goals and wishes to build a green industry (NOU 2023:3, p. 9), thus Norway must find ways to handle the energy transition while also ensuring there is enough power available for society and industry. With the ongoing energy transition Norway has further decided to electrify a large part of society, leading to a need for increased power production and green and renewable energy sources. Norway has focused mainly on building capacity in hydro and wind power, because of the great comparative advances that are present for renewable energies.

But hydro and wind power projects are conflict-ridden and experience a great deal of resistance from local communities. Such conflicts can be seen from the Alta case in the 1970s and 80s (Andersen & Midttun, 1985), where local communities opposed plans of exploiting the Alta-Kautokeino River for hydropower. Demonstrations across Norway surpassed political parties, and the biggest feeling of being treated unjustly was felt by the Sami people (Andersen & Midttun, 1985, p. 318). Similarly, one can see the same kind of conflicts today with wind power projects (Vasstrøm & Lysgård, 2021; Eikland et al., 2023), and much of the debate surrounds unjust processes, little to no inclusion, and the experience of receiving little to no benefits from the projects.

Several reports (Buvik et al., 2022; NOU 2023:3; Koestler et al., 2020) state that intermittent energy sources provide unstable power production. This is the nature of intermittency, because

wind power produces power when it is windy, while a hydro plant depends on rainfall. It has been noted that Norway needs power production flat 24/7 and that there is a greater need for energy sources that are less vulnerable to exogenous factors such as extreme weather, drought, or ill-intended acts. Both the Energy Commission (NOU 2023:3, p. 18) and the Government[1] have emphasized that nuclear power (NP) is irrelevant for Norway. Concurrently there are several municipalities, industries and organizations that want NP because they see the potential NP entail, and they want to prepare and mitigate any future power shortages. It is reasonable to believe that NP could be as conflict-ridden as hydro and wind projects, and one can already see signs of this in public debate (Rystad Energy, 2023; Emblemsvåg, 2024; Hjelmeland & Nøland, 2024).

One of the reasons why NP might be conflict-ridden and contested can be seen from previous accidents. There have been three major nuclear accidents since the 1970s, namely Three Mile Island (1979, The U.S.), Chernobyl (1986, Ukraine), and Fukushima (2011, Japan) (IAEA, 2016, p. 1), which had different causes and resulted in different consequences. However, the first recorded nuclear reactor accident happened in 1952 in Chalk River, Canada (Government of Canada, 2021). Nevertheless, Norway has had nuclear power since 1951, when the first research reactor started operating (Sæle & Kristiansen, 2023, p. 3). This gives Norway a comparative advantage when it comes to research on safety and security on NPPs, but also on how to operate big energy installations. This could furthermore highlight that nuclear technology is not new to Norway. This is one of the reasons why the nuclear sector is an interesting topic to study, but even more interesting is studying the Norwegian nuclear regime to delve deeper into the reasons for why Norway has not embarked on a nuclear journey. Additionally, to investigate whether NP might experience the same kind of conflicts as wind- and hydro projects could highlight knowledge gaps that will be useful in the future.

1.2 Previous research

There are many ways of researching NP and how a country can establish it. Within risk governance and risk analysis there are several paths to different research areas. Cost-analysis

[1] This is also a guidance given from the Government, as seen in news articles from 2023 (Nyhus, 2023). https://www.nrk.no/vestland/staten-seier-nei-til-a-forske-pa-kjernekraft-1.16377091

are often prevalent in risk research, and one way of doing this is with a Levelized Cost of Energy (LCOE). LCOE is "the weighted average life cycle cost of producing energy" (Emblemsvåg, 2023, p. 1243), essentially calculating the cost of a certain energy source throughout its life. Another research area is environmental risk governance (Sidortsov, 2014; Mauelshagen et al., 2014), which is tightly connected to environmental policies and decision-making processes. Energy justice research has, among other areas, conducted studies on fuel poverty as a result of energy policies (Walker & Day, 2012), and intersecting inequalities such as feminist, indigenous, and anti-racist approaches (Sovacool et al., 2023). These are interesting and important areas to study but does not adequately highlight the importance of a just risk governance process on energy infrastructure projects (EIP). The following paragraphs will thus highlight the knowledge gaps present in Norwegian context for the nuclear sector and show the importance of this knowledge for future EIP.

1.2.1 Risk governance in Norwegian context

Fukushima and Japan after 2011 has been one of the most studied cases, because of its overarching consequences. Some authors have argued that the Fukushima accident was a result of poor risk communication, lack of transparency, and a collusion between government, the regulator and the nuclear industry (Wang et al., 2013; Figueroa, 2016). It was a result of an overall system failure, ranging from technical issues, regulatory weaknesses, to nuclear safety assessments (Figueroa, 2016, p. 264). Other issues that have been pointed out is the lack of inclusion and participation in the land use planning (Figueroa, 2016; de Oliveira & Paleo, 2016). This research shows that the nuclear energy sector is exposed to diminished leadership and intertwined relationships that needs to be mitigated with effective and efficient risk governance.

Risk governance is a widely studied subject with varying focus, ranging from context-specific cases to an overall review of existing literature. Studies on risk governance related to stakeholder involvement find that involvement should be set as a requirement for effective and fair risk governance (Renn, 2015; De Marchi, 2003). Searching for review articles on risk governance in Norway, published between the years 2000-2024, on Google Scholar provides the author with 460 articles (May 6th, 2024). The articles range from risk governance in offshore oil and gas (Kringen, 2014), risk governance approaches and knowledge gaps in connection to climate-related hazards in Longyearbyen, Svalbard (Johannessen et al., 2024), and genetic engineering in aquaculture (Myhr & Dalmo, 2005). Searching for risk governance in a nuclear

context provides a similar result, with 449 articles on Google Scholar (May 6th, 2024). A relevant article by Van der Vegt (2017) provides a literary review of articles about risk governance, where one of the findings is that there is an awareness amongst researchers that there is a lack of evidence on the impact of public participation in risk governance (Van der Vegt, 2017, p. 14). This demonstrates a research gap for how the risk governance process can be improved if public participation is enhanced and emphasized, which is what this thesis will try to highlight.

1.2.2 Energy justice in Norwegian context

Some researchers have studied energy justice in light of nuclear power. Jenkins et al. (2017) studied energy justice in the UK in reference to their strategy to produce 16 GW nuclear power by 2030. The authors found that there was a discrepancy in perceptions about responsibility for justice (Jenkins et al., 2017, p. 839), which is a re-occurring phenomena. Heffron (2022) argued that energy justice should be applied to the whole life-cycle of an energy project to lower the risk profile, but also how stakeholders might challenge each other because justice for many might be subjective. It is important to consider that some justices are detailed in the universal human rights and should thus not be subject for discussion.

Furthermore, in a literature review conducted by Segreto et al. (2020), it was found that social acceptance for renewable energy largely depends on trust between the community and developer, which should be done through participation and relaying information. This study focused on wind farms and its impact on social acceptance in Norway. It is additionally found in Heffron & McCauley´s (2017) contribution that energy justice has become multidisciplinary, thus providing a greater nexus between different parts of society (e.g. politics, industry, decision-making). They also emphasized that energy justice may help bring heterogeneity to the energy debate (Heffron & McCauley, 2017). This further reveals the intertwined relationship between civil society and decision-making and emphasizes the importance of including lay people in processes and decisions that affect their day-to-day life. It also points to a need for further research on energy justice in light of nuclear power in Norway, in part because it has many knowledge gaps seeing that it has been a focal point in Norwegian politics since the 1970s.

Energy justice research in Norway has focused mostly on wind and solar power (Vasstrøm & Lysgård, 2021; Eikeland et al., 2023; Lindberg & Inderberg, 2023), how the energy transition

might enhance energy injustice (Sovacool et al., 2019), and local acceptance towards energy transition and energy technologies (Svartdal & Kristoffersen, 2023). This preview of articles is not exhaustive, but a symptom for many of the articles the author has found. Concurrently is much of the research is from foreign researchers who do not focus on Norway, but rather conceptualize the theory and analyze cases from different regions (van der Horst, 2007; Heffron & McCauley, 2014; Fuller & McCauley, 2016; Healy & Barry, 2017). This further highlights the need for more context-specific research in Norway in regard to energy justice and nuclear power.

1.3 Problem statement and research questions

The aim of this study is to investigate the regulatory framework and procedures in Norway that can connect to nuclear implementation, in creating a just energy transition. With doing so, the study aims to fill in some of the present knowledge gaps surrounding nuclear power in Norway. The problem statement is of interest to the regulatory bodies and the society, because of nuclear power´s potential role in the future energy mix. There is an increasing interest in Norway to implement NP, but there is little research on the nexus between risk governance and energy justice, two of the theoretical frameworks used in this thesis. Much of the research on energy justice has looked at the influence of wind- and solar power (Gilbert, 2021; Lindberg & Inderberg, 2023; Vasstrøm & Lysgård, 2021; Eikeland et al., 2023) on regulatory framework and policies. Furthermore, it is necessary to investigate the connection between risk governance and energy justice when looking at implementing new technologies, because of the intertwined relationship between policies, energy security and society.

This study's problem statement is therefore:

> *How can Norway ensure a legitimate and transparent process with regards to the implementation of nuclear power, with the goal of enhancing the energy security?*

To specify and answer the problem statement, two research questions (RQs) has been formulated.

RQ 1: What are the regulations and procedures needed in Norway to implement nuclear power?

- The question will analyze the present regulatory framework in Norway and investigate if there is a need for a more thorough framework and regime to implement nuclear power by using meta-regulation and risk governance.

RQ 2: How can Norway improve its procedures when diversifying its energy mix?

- This question seeks to investigate what possibilities Norway has for further diversifying their energy mix in light of energy justice.

The results from this study can have possible policy implications when deciding the future of the Norwegian energy system, but also for decision-makers and its processes as a way of showing the importance of including lay people in the processes to gain local acceptance for EIP.

1.4 Limitations

Nuclear power is a large subject that is dynamic and undergo changes continuously. Nuclear power plants and its technology are especially subject to change, seeing that many countries and researchers are working to improve both the technology and the security, for lay people, the people working there and the facility itself. Though the study is focused on the regulatory framework and procedures in Norway, it will use many international articles that have researched other countries. The author will use this as a knowledge base when discussing possibilities for Norway, seeing that there have been conducted few studies in a Norwegian context. Lastly, because NP is subject to public debate with a varying degree of factual information, the author wanted to investigate what is actually possible in Norway. This is of relevance for the Norwegian public because of the ongoing debate surrounding nuclear power.

Because NP is a large area that creates many possible research ideas, the author had to delineate the scope of this study to regulations, procedures, and inclusion. This delineation done based on the timeframe for this thesis. There are, nevertheless, a larger scope that could have been studied and that is of interest to the general public. One idea within this larger scope include a better focus on stakeholder's involvement and inclusion, which the author did not have time to focus more on.

1.5 Structure of the study

In this first chapter I have described the background, and previous research for the study's research questions. The second chapter will contain context that is relevant to understand the Norwegian energy system, while the third chapter refers to different theoretical frameworks, which will be the foundation for the discussion. The fourth chapter will focus on the

methodology used before the fifth chapter presents the empirical data. The sixth chapter will discuss the data based on the theoretical framework presented in chapter three and will be divided into three sub-chapters. The last chapter will present the conclusions and try to give an answer to the research questions.

2 Context

It is relevant to highlight how the Norwegian energy system works and what it consists of, to further contextualize the reasons for this thesis. This chapter will therefore explain the key points of the energy system in order to place NP in the mix.

2.1 Energy system in Norway

This section wants to highlight the status of Norway´s energy system and mix, to show the need for a more diversified energy mix as a way of mitigating future energy shortcomings. The energy system and its components are part of a country's critical infrastructure, which is essential to the functions of a society (Svegrup et al., 2019). They found that reducing vulnerabilities by improving critical infrastructure can be done by i) identifying the critical parts of the infrastructure and implement measures to protect the critical parts, or ii) build a more robust system by adding redundancies as a way of strengthening the overall system (Svegrup et al., 2019, p. 1981). It is thus important that it functions optimally and covers the need of both lay people, the industry, and the state. It is not possible to establish new industry or continue the decided economic growth without an increased power production, because of the forecasted power deficiency by the year 2030 (Buvik et al., 2022).

Norway´s current energy mix consists mainly of hydro- and wind power as renewables, with hydro dams producing 90 percent of the power, with estimations of production varying between 106-187 TWh/yr (Koestler et al., 2020, p. 9). Wind produces around 13 TWh/yr, which is approximately 17.5% of the total power production, followed by photovoltaic power which produces less than 0.1 TWh/yr (Koestler et al., 2020, p. 9). In Norway the total power usage is circa 134 TWh/yr (Koestler et al., 2020, p. 9), and with the energy transition this is expected to increase (Meld. St. 11 (2021-2022)). When needed, Norway exports and imports power with Sweden, Denmark, Finland, The Netherlands (DSB, 2016, p. 87), previously also with Russia. Both Sweden, Denmark and Finland have a high amount of variable renewable energy (VRE) energy sources that are greatly impacted by weather changes. Because the Nordic countries have similar weather systems, they are also subject to the same weaknesses in the energy systems, as argued by Koestler et al. (2020, p. 13).

VRE are largely intermittent and variable, meaning that their production depends on the weather (NOU 2023:3, p. 68). Hydro power can be saved through dams and hence be regulated, while wind and solar power cannot be saved *before* it has produced energy (NOU 2023:3, p.

68). Additionally, VRE can lead to challenges for the power system because of the fast changes they are subject to (Koestler et al., 2020, p. 20). Weather changes are the biggest challenge for VRE (Koestler et al., 2020), because the weather is volatile. This has implications for the power production and needs to be mitigated through adjustable power production.

Because the similarities in the weather patterns can produce a higher share of power and electricity when it is needed the least, and not enough power at times when the consumption is high (Koestler et al., 2020, p. 13), it is important to diversify the energy mix with sources that can be regulated. Sweden and Finland have mitigated this weakness, i.e. added redundancies and created a more robust system, with nuclear power (World Nuclear Association a; World Nuclear Association b, 2023). NP is an energy source that can be regulated by the operators, while it also produces power 24/7 and it is not an intermittent energy source. As mentioned in NOU 2023:3 (p.72), Norway needs to diversify its energy mix to reduce vulnerabilities. Norway can import power from neighboring countries when there are shortages, but neighboring countries will likely experience shortages at the same time as Norway because of the weather and intermittencies of the renewable energy sources (NOU 2023:3, p. 72).

Figure 1 is derived from NOU 2023:3 (p. 52) and shows how much power each energy source produces in a normal year. Hydro power is the biggest contributor to the power production, followed by wind, which can be used as an argument as to why there is a need for more reliable energy sources which are not intermittent. This is in line with Svegrup et al. (2019) and their argumentation about adding redundancies to reduce vulnerabilities in critical infrastructure.

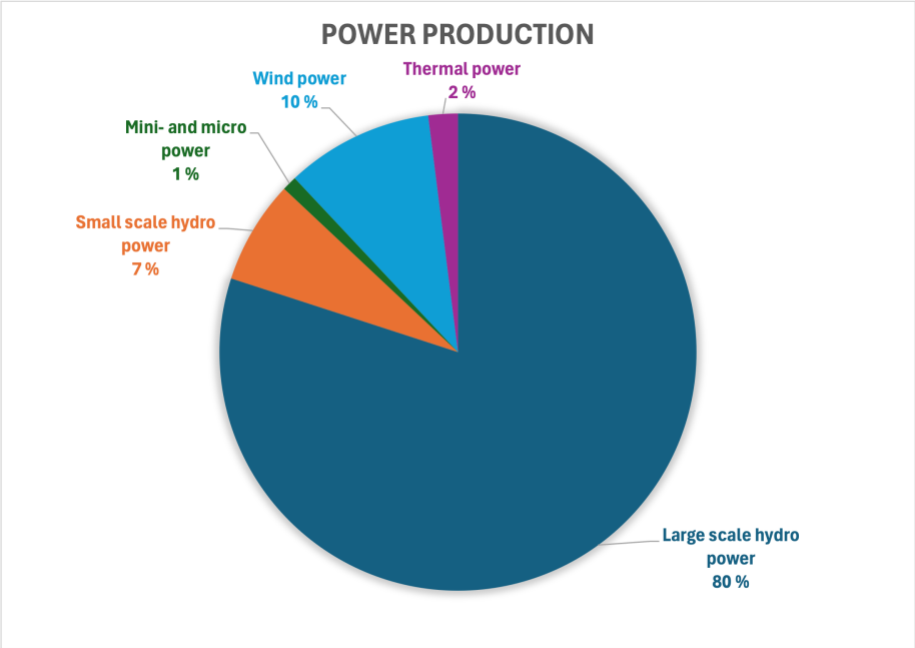

Figure 1. Power production in a normal year in Norway. Derived from NOU 2023:3, p. 52, translated by author.

Future power usage differs from different calculations as shown in Table 1 below. The calculations show a great increase in the expected demand, which shows that Norway must increase their power production to at least 208 TWh by 2050, when calculating the average number between the four analyses given (Table 1). The current usage as of 2023 is around 138 TWh (NOU 2023:3, p. 74). The biggest contributor to this increase is said to be the industry and transport sector (NOU 2023:3, p. 76), mainly because of the electrification and energy transition. Connecting the expected use of power with Norway's need for greater energy infrastructure expansion, it is reasonable to argue that wind, hydro and photovoltaic energy sources are not enough. There is resistance against wind power infrastructure amongst the public, as mentioned in the NOU 2023:3 (p. 65), and acceptance is pivotal for the survival of such projects (Segreto et al., 2020).

Table 1. Expected demand in power usage in TWh. NOU 2023:3, p. 76

	2020/2021	2030	2040	2050
NVE (2021)	138	159	174	
Statnett (2021)	140	172	183	190
DNV GL (2021)	144	188	213	232
Prosess21 (2021)	134			216
Thema (2022)		173	185	194

3 Theoretical framework

This chapter will present the theoretical framework used to answer the research questions in this study. Firstly, it conceptualizes regulatory regimes and the different roads a country can take, followed by an introduction of risk governance and an in-depth explanation of some of the aspects of risk governance that are relevant for this thesis. Thereafter it presents energy justice as an aspect to risk governance, namely how it is important to include justice in the risk governance when incorporating new energy sources in the energy mix. Lastly, it presents an explanation as to how the theories will be used considering the Norwegian context of energy security, regulatory processes, and nuclear power.

RQ1 seeks to analyze present regulations and procedures in Norway and how, or if, they can be used to implement nuclear power. Both energy justice and risk governance are relevant for this analysis because they look deeper into the human aspect and policy aspect of regulations. RQ2 looks at technological options that are attainable to maintain a secure and sustainable energy system. Within this RQ it is important to see how energy justice might impact choice of technology, and at the same time analyze if the regulatory regime makes diversifying possible.

3.1 Different regulatory regimes

It is of relevance to conceptualize the different types of regulatory regimes in order to analyze the current regulations and procedures that are present in Norway. It is important that an organization is subject to external regulation, so that the organization itself does not have the sole responsibility of creating rules and regulating themselves (Grote, 2012, p. 1986). Additionally, implementing self-regulation can lead to better adaptation of the safety management, because the organizations to a lesser extent are bound by rigid regulations and regulators (Grote, 2012, p. 1986). A conceptualization of such self-regulation is meta-regulation, which, according to Gilad (2010), involves a regulatory framework that encourages organizations to develop their own internal regulatory mechanisms.

The nuclear industry is dominated by extensive external regulation (Grote, 2012, p. 1986), and they are subject to rapid technological change in the form of ever-evolving systems and possibilities. Meta-regulation entails that organizations not only identify risks and have internal control systems, but also continuously evaluate their internal systems and improve these systems (Gilad, 2010, p. 488). Self-assessment is vital, and the organizations' self-assessment is subject to regulatory oversight by the regulatory agencies (Gilad, 2010, p. 488). Furthermore,

learning is important for both the organization and the regulatory agency, enhancing the efficiency and effectiveness of meta-regulation.

The learning process is continuous and integral to the regime (Gilad, 2010, p. 494). This includes the competence level of both the external regulators, and those working in the regulated organization. This is important because the regulators base their judgments mainly on the organization's self-evaluation (Gilad, 2010, p. 497), but the regulators also conduct independent evaluations. Gilad (2010, p. 497) note that this type of learning could encourage "the regulators and regulatees to develop a shared understanding of what good systems and outcomes look like". It is also important that the regulators and regulatees trust each other, and Gilad (2010, p. 497) states that this trust can only be achieved through external political support and public trust.

3.2 Concepts of risk

Risk has several definitions depending on the subject of matter, and common for most of them is that risk is about both negative and positive consequences of an activity, and uncertainties regarding what the consequences will be (Aven & Thekdi, 2022, p. 9). The risk-definitions can be divided into two categories, that risk is expressed through probabilities and expected values, or that risk is expressed through events/consequences and uncertainties (Aven & Renn, 2010, p. 3). One definition of risk that Aven and Thekdi provide is that risk is "*the consequences of the activity and associated uncertainties"* (2022, p. 11). To operationalize this definition an example could be building a nuclear power plant, where one positive consequence is a stable generation of power. On the other hand, a negative consequence is that a potential meltdown could be catastrophic for the environment and people close by.

A second and more useful definition of risk, which will be used in this thesis, can be defined this way: "*Risk refers to uncertainty about and severity of the events and consequences (or outcomes) of an activity with respect to something that humans value*" (Aven & Renn, 2010, p. 8). Something humans value can be seen as life, environment, or money. The uncertainty of a risk can be defined by a person assessing the risk it is perceiving, and hence risk perception is an important aspect of risk. As Aven and Renn (2010, p. 10) puts it "*risk … requires a mental construction of the uncertainty (knowledge) dimension*".

Often, one differentiates between objective and subjective risk. Objective risk focuses on measuring the likelihood or probability, including the impact of risk on people (Nobanee et al.,

2021, p. 1-2). One type of measuring objective risk can be frequency or magnitude, i.e. the number of times an accident has occurred or the size/extent of an accident. Subjective risk on the other hand, is more focused on the assessors' knowledge and skills that can influence the level of risk (Nobanee et al., 2021, p. 2), i.e. subjective risk is synonymous to perceived risk. Objective risk is important because it can paint a picture about the actual risk of an installation, such as an NPP, and describe the actual risk connected to it. The objective risk is also important for the risk perception and communication, because it helps communicate facts about risks that could shape the perceived risk for recipients.

Risk perception is often dependent on our perceived control of the risk and our knowledge regarding the event posing the risk. Aven & Thekdi (2022, p. 129) define risk perception as *"a person's subjective judgment or appraisal of risk, taking into account social, cultural and psychological factors"*. In addition to this, risk perception can be influenced by technical risk assessment, which normally entails analysis based on large data samples looking at causal relationships, in short resulting in a professional risk perception (Aven & Renn, 2010, p. 24). Other parameters that are included in risk perception and might affect a person's risk perception are physiological traits, such as gender, age, occupation, and socio-economic status (Weber & Milliman, 1997, p. 129).

Physiological traits are important to understand the different risk perceptions among people and scientists. These traits guide how people respond to a particular hazard (Frewer, 1999, p. 569). Another important factor to consider because of this is that people's risk perception should help determine how risk is communicated, because of the dynamic nature of the risk perception (Weber & Milliman, 1997). Those who communicate the risks, such as the regulatory authorities or the owner of the power plants, need to take lay people's perception into consideration, so that they make sure that the communication is understandable and received by those affected by the risks.

3.2.1 Risk governance

The International Risk Governance Council (IRGC) has developed a framework for effective and transparent risk governance, which is designed to assist societies in generating knowledge to address and respond to risks (Renn, 2020, p. 93). The framework has a structure consisting

of four phases: pre-assessment, appraisal, characterization/evaluation, and risk management (Renn, 2020, p. 98). Figure 2 below shows a visualization of the framework.

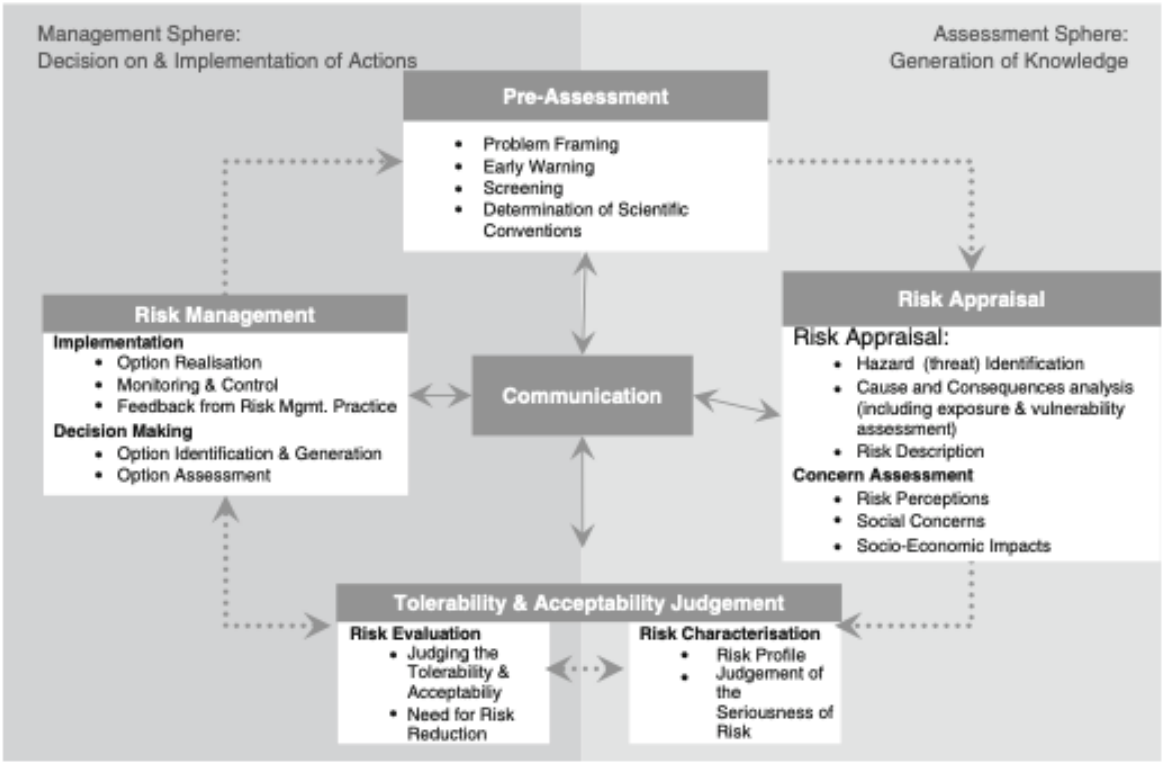

Figure 2. Visualization of the IRGC risk governancce process (Aven & Renn, 2010, p. 57)

Because of nuclear power being in the infant phase in Norway where different municipalities, organizations and businesses are looking into the possibilities of implementing it, it is decided that the scope of this thesis include pre-assessment and risk communication. The other elements of risk governance are decided to be outside the scope of this thesis. This is to get a better look at the current regulatory and policy climate in Norway. The concern assessment in the risk appraisal will also be mentioned but used in connection with the beforementioned factors and energy justice, which will be explained in the following sub-chapter.

3.2.1.1 Pre-assessment

Pre-assessment is the first phase in the IRGC framework for risk governance. It clarifies the different perspectives on a risk, defines the issue, and forms the baseline for how a risk is assessed and managed (IRGC, 2017, p. 11). This phase is in the nexus between the management sphere and assessment sphere, and therefore important for all the steps in risk governance. It is in the pre-assessment phase that hazards, potential, risks, and societal concerns are identified and analyzed (Aven & Renn, 2010, p. 58). There are several questions one can ask in the pre-

assessment to figure out what the situation is, and examples of these questions that are relevant for this thesis are: what are the risks and opportunities; who are the stakeholders; what are the current legal/regulatory systems and how do they potentially affect the problem? (IRGC, 2017, p. 12).

Aven & Renn explain assessment as "the tasks of identifying and exploring (preferably in quantitative terms) the types, intensities and likelihood of the (normally undesired) consequences related to a hazard or threat" (2010, p. 51). Pre-assessment is divided into four different parts: **problem framing, early warning, screening, and determination** of scientific conventions (IRGC, 2017, p. 10). **Problem framing** is the process of selection and interpretation of phenomena as relevant risk topics (Aven & Renn, 2010, p. 67; IRGC, 2017), in other words it is the process of defining what counts as risks. There are several interpretations of what risks are in the nuclear sector, depending on if you are a government agency, an organization working with nuclear energy, or if you are a lay person. It is important that all stakeholders are included in the definition process because the risks expand to different parts of society. Concurrently, the type of risk definition will vary because of the knowledge level of the defining entity and how risk communication is perceived.

Early warning (and monitoring) refers to institutions (whether it be governmental, business, or civil society) identifying events to be able to detect hazards and risks, while providing insights to the extent and/or severity of the hazards and risks (Aven & Renn, 2010, p. 68). This step is important to be prepared for potential risks in the future for the technology or case that is analyzed, so that these risks can be minimized. Society is an important factor in this case, because they live where the potential hazards occur, and therefore might be the first to see if a hazardous event happens. Even though a NPP has its own safety barriers and safety systems, there must be several monitoring actors in case of organizational failures (Wang & Chen, 2012). This highlights the importance of an independent regulatory oversight and the knowledge foundation for all stakeholders involved in the process.

Risk screening is the allocation of management procedures and protocols (Aven & Renn, 2010, p. 68). In Norway there is a shared responsibility in the case of radioactive preparedness between the Norwegian Radiation Protection Authority (DSA), the Norwegian Directorate for Civil Protection (DSB), and several other government agencies and institutions (Sæle & Kristiansen, 2023, p. 63). Additionally, the organization responsible for a NPP will be responsible for internal procedures and regulation. The people working at a power plant will be

responsible for following protocols and safety procedures within the plant, and they will furthermore be responsible for evaluating their systems. The risk screening will thus help in determining the routes for risk assessment and management, in meeting with risks (Renn, 2008, p. 13).

The last part of the pre-assessment is the **selection of conventions and procedural rules**, which are used for assessing the risk and concerns related to it (Aven & Renn, 2010, p. 68). While the other parts of the pre-assessment highlight the importance of lay people's knowledge and efforts, one can label this part as the "technocratic" part of the pre-assessment because of the expert knowledge exerted. This refers to rules for i.e. the handling of negative effects related to power plants, how societal concerns should be handled, and how distributional effects should be handled (Renn, 2008, p. 13). Norway has several national Acts that provide requirements to the nuclear sector (DSA, 2019, p. 8), and they are signatories to a number of international conventions and agreements (such as Convention on Nuclear Safety, Convention on Early Notification of a Nuclear Accident, and The UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters) (DSA, 2019, p. 15).

3.2.1.2 Risk appraisal

Equally important is the risk appraisal step. This includes the scientific risk assessments, information about public risk perception, and implications of the direct consequences of the activity (Aven & Renn, 2010, p. 71). Risk researchers identify risk sources/hazards and analyze possible consequences that could be induced from the source/hazard, followed by social scientists and economists who identify and analyze issues that both society and individuals connect to a specific risk source, and how this may impact them (Aven & Renn, 2010, p. 71). This step will be helpful when discussing the possibilities of new energy technologies in a country, because the society´s risk perception and concerns should be used in the decision-making process of implementing and creating new policies for specific technologies.

The scientific assessments produced in this step should uncover secondary implications, such as economic losses and liability, political mobilization, and behavioral patterns (Aven & Renn, 2010, p. 72). These are important implications to understand because of the nature of risk perception and its potential consequences for risk managers and the overall risk behavior. One example could be that if a community's risk perception and concerns for a potential new nuclear power plant is not considered, it could damage the community's trust towards the decision-

makers (e.g. local municipality and national government), thus creating a narrative that their meanings and safety does not matter. It is nevertheless important to remember that these assessments are based on scientific estimates of physical, economic, and social consequences (Renn, 2008, p. 26), and do not include direct involvement with stakeholders.

One assessment that do involve stakeholders is the **concern assessment.** This is key to understand the values and socio-emotional issues associated with a risk (IRGC, 2017, p. 15). These are important to understand because they "determine the social and cultural ambiguity about a risk issue but also influence the attitudes toward risk- and risk-taking behavior" (IRGC, 2017, p. 15). A concern assessment should thus include questions about the opinions, values and concerns stakeholders may have, the social response to the risk, and if the risk managers are likely to experience conflicts and controversies due to differences in risk perception, in addition to other questions (IRGC, 2017, p. 15). Such an assessment may uncover potential deficits in the risk governance, but it could also uncover status quo of society's risk perception and thus be of help to better the risk communication.

3.2.1.3 Risk communication

At the core of risk governance is communication. Risk communication's goal is to help stakeholders and the public arrive at a balanced judgment and make risk-informed decisions (Aven & Renn, 2010, p. 159). It is a necessary activity partly given by law and regulation, the public pressure and stakeholder demand (Aven & Renn, 2010, p. 160). At the same time, it can help build trust with the government and its institutions if they show transparency and goodwill in their risk communication.

Aven & Renn (2010, p. 161) state that the first step in communication is to find a common denominator. Furthermore, they have classified three typical communication levels that are often addressed: 1) factual evidence and probabilities, 2) institutional performance, expertise, and experience, and 3) conflicts about worldviews and value systems (Aven & Renn, 2010, p. 161). On the other hand, it is likely that what information is believed to be true is contingent on the social environment surrounding the risk communication (Frewer, 2004, p. 393), especially seeing that risk perception is influenced by the people around you, which again influence the way you receive and decode information.

The first level of communication encompasses factual arguments and scientific evidence regarding probabilities and potential hazards/threats (Aven & Renn, 2010, p. 161). The

objective is to put forward information to try to create a common understanding of the problem, while at the same time ensuring that the information is understood, at least to a bigger degree. The second level refers to the need to communicate with stakeholders and the public. It is up to the risk managers and its institutions to relay information that makes them trustworthy, while communicating the distribution of benefits and risks to lay people (Aven & Renn, 2010, p. 162). Trust is crucial for all parties, and that can be gained through transparency, effectiveness, and by showing themselves competent for the case (Aven & Renn, 2010, p. 162; Frewer, 2004, p. 393).

In the third and final level, conflict is in the middle and entails conflicts along different social values and cultural lifestyles (Aven & Renn, 2010, p. 162). This level of communication can be seen in line with the traditional center-periphery cleavage from political science. Center-periphery was in early modern Europe between feudal lords and town dwellers who was in conflict about the price of food (Clarke, Golder & Golder, 2018, p. 603). Today one can see a divide between the interests of rural and urban communities, and these interests are often the driving force for how communication is received. An important part for mitigating this, Aven & Renn (2010, p. 163) states, is increasing stakeholder involvement with citizen panels, debates, and open forums.

3.3 Energy Justice

Energy justice is a concept that aims to provide all individuals with safe, affordable, and sustainable energy (McCauley et al., 2013, p. 2), with a focus on how that can be achieved through energy policy. To combat the injustices that can be created by the ongoing energy transition from fossil fuels to renewable and low-emission energy, energy justice is a relevant theory with dimensions created to understand and mitigate such injustices. McCauley et al. (2013) was the first to conceptualize what they call "the triumvirate of tenets in energy justice", which are the core themes for research in the energy justice literature.

"The triumvirate of tenets" are distributional, procedural, and recognition justice. They can be used to answer different aspects of justice and injustice in the energy system, and the themes overlap with each other (McCauley et al., 2013). According to Heffron & McCauley (2017, p. 659) the article published by McCauley et al. in 2013 were the first to define energy justice as a concept with a following framework (the triumvirate of tenets), and after that there has been an increasing amount of literature on the subject from different perspectives (Fuller & McCauley, 2016; Heffron et al., 2015; Lindberg & Inderberg, 2023). Common for many of the

articles after 2013 is that researchers see energy justice in light of the energy transition, and how the transition either strengthens or weakens the experienced justice through the energy system.

In the infant phase of the conceptualization, McCauley et al. (2013) argued for the need to focus on energy policy, and how political decision-makers and stakeholders in the energy system should focus more on including energy justice in policies and processes. Heffron & McCauley (2017, p. 660) states that while this is important, it is difficult to see how energy justice works in practice, i.e. how it is used as input to policies. Further, they argue that there is a need for a knowledge base, where researchers across disciplines build knowledge as they do in other disciplines (Heffron & McCauley, 2017, p. 660).

3.3.1 Distributional justice

Distributional justice represents the need for a just distribution of benefits and ills, and it concerns both the siting of energy infrastructure and access to energy for all members of society (Jenkins et al., 2016, p. 176). Unequal distribution can be used about both environmental benefits and ills, and their responsibilities such as risk (McCauley et al., 2013, p. 2). The area where distributional injustice is most prevalent is the siting of energy infrastructure, as seen with wind parks and photovoltaic parks in Norway (Lindberg & Inderberg, 2023).

The process for implementing new energy sources, at this time mainly renewable energy (RE), will have implications for distributional justice and injustice, if not taken into consideration (Sovacool et al., 2019, p. 582). Distributional justice argues for a greater distribution of not only the infrastructure and access to energy, but also distribution of access to political and economic power (Healy & Barry, 2017, p. 452). There is great power in having access to decision-making processes and economic resources, and if the distribution of this is uneven it could help enhance the injustice.

Important for this tenet is the distribution of costs, both in monetary form and cost in terms of loss of spatial areas. Sovacool et al. (2019, p. 588) state that this tenet can "help in developing energy systems in which costs are shared and participants benefit as equally as possible". Participants in the case of this thesis are the people and communities that live where the energy infrastructure is intended to be built, in addition to other stakeholders that hold a special interest in the projects.

Geographic and spatial factors, such as specific sites of transportation, storage, production, and waste disposal affect where energy infrastructure projects (EIP) can exist (Finley-Brook & Holloman, 2016, p. 3). EIP could additionally be important for local communities with providing new and more jobs, increased tax incomes for municipalities, and thus help populate the periphery which in turn is important for national security. One example is that investing in EIP in communities where there is decommissioned energy infrastructure, such as coal mines or fossil fuel energy, can remediate the loss of jobs and thus increase the distributional justice.

The location dimension, i.e. where the energy source is supposed to be located, who decides the location, are centralized or decentralized energy systems more attractive or effective, among other questions is a suitable dimension for the tenet of distributional justice, but also procedural justice because of its cohesion with Not-In-My-Backyard (NIMBY), which will be explained below. Additionally, the diversity dimension can be put within the distributional justice, seeing that it is the decision-makers who decide which technology that is to be implemented.

3.3.2 Procedural justice

Procedural justice concerns if and how stakeholders are included in the decision-making process (Jenkins et al., 2016, p. 178). This regards issues of public participation, due process, and representation (Sovacool et al., 2019, p. 588). What is important here is identifying who makes rules and plans for energy infrastructure, but also who *can* have a say in the process to ensure transparency and fair representation (Sovacool et al., 2019, p. 589), which also are important factors in liberal democracies.

One sentiment often used to describe procedural justice is Not-In-My-Backyard (NIMBY), which can be used to understand why people and local communities might oppose energy infrastructure projects (van der Horst, 2007). NIMBY may offer several explanations as to why local communities oppose energy infrastructure projects, such as environmental impacts: visual appearance; procedural factors, and diminished property factors (Carley et al., 2020, p. 2). Wind energy is the most common energy source to study for this sentiment because of its fast-growing pace and implementation (Carley et al., 2020, p. 4), but it is reasonable to argue that this can be relevant for nuclear power as well.

It is important that changes in energy regimes address inequalities in power (Healy & Barry, 2017, p. 452), and thus that justice is incorporated in the policy design. The public is increasingly showing interest in energy policy and therefore also in the decision-making

process (Healy & Barry, 2017, p. 453), and this is showing a change in how the public might perceive their own role in the political system. Additionally, there was an increase in local and national protests against wind power from 2019-2021 (Vasstrøm & Lysgård, 2021, p. 5), which can be argued is a symptom of society's way of transforming the energy system. These are all important factors for procedural justice and need to be met by policy- and decision-makers to ensure transparency.

3.3.3 Recognition justice

The third tenet focuses on identifying vulnerable people, groups, or minorities, who may experience a worsened state of vulnerability because of the energy transition (Sovacool et al., 2019, p. 589). Recognition justice looks at discrimination, cultural, social, and historical context, and how injustice can be mitigated (Jenkins et al., 2016, p. 177). Vulnerable people here might be the chronically poor, elderly, unemployed, or indigenous people, who often face adversity. An important aspect within recognition justice is to acknowledge diversity and the values that come from the diversity, while ensuring equity and equal human rights for all (Sovacool et al., 2023).

Although recognition justice is important to discuss in the bigger picture and needs to be included in future policies, it is outside the scope of this thesis and will not be used as part of the theoretical framework. It is hence only mentioned briefly here.

3.4 How the theoretical frameworks will be used

This thesis will use meta-regulation as a basis when discussing the procedures and regulations that are needed for Norway to implement NP, while the first phase of risk governance, pre-assessment, explore deeper into the aspects surrounding problem framing, early warning, screening, and determination of scientific conventions and procedures. Energy justice will be used as an aspect of risk governance because it will be argued that it enhances the risk governance. One important aspect in pre-assessment is knowledge generation (Renn, 2008, p. 14), which is also an important part of the meta-regulation. This shows the intertwined relationship between the frameworks, but also how they can be used together. Knowledge is about all potential risks and hazards connected to an NPP, but also the competence of those involved in the implementation process, regulation, and decision-making. This is prevalent in the entire risk communication process. One way of acquiring knowledge is by including civil stakeholders and designing policies in a way that ensures fair representation and transparency. This will be shown through the inclusion of the energy justice framework.

4 Methods and Study Design

The purpose of this study is to explore how Norway can ensure transparent and legitimate procedures while implementing nuclear energy in their energy mix, and how the tenets of energy justice and the framework of risk governance may have implications on the energy policy in Norway. The process of choosing methodology is therefore designated through the thesis's problem statement and research questions. For this purpose, I have chosen a thematic analysis by Richard Boyatzis (1998) as research strategy and design.

In this chapter I will explain the reason for choosing qualitative research as a method, by describing the methodological choices that have been made. I will begin by clarifying the research design and its context, before explaining the data collection methods, and the sampling of interview objects. Thereafter, I will outline the data analysis method that is used, followed by an explanation of the thesis's validity and reliability. In conclusion I will acknowledge potential limitations before a concise summary is provided.

4.1 Qualitative research design

Qualitative research methods "aims to capture meanings and experiences that are not quantifiable through numbers" (Dalland, 2022, p. 54). Common methods for data collection in qualitative methods are interviews, observations, and document analysis (Brinkmann & Tanggaard, 2012), which are methods that provide the researcher with direct insights to the researched phenomenon. Studies using qualitative methods seek to understand, interpret, or contextualize phenomena through inductive reasoning (Yilmaz, 2013, p. 313). By choosing a qualitative method, which has been done for this thesis, I am able to appropriately showcase my understanding in depth about the Norwegian energy mix and the state of its procedures and regulations by mapping out the opinions to scientists and people in the industry. As a way of strengthening my data sets, I have chosen two different modes for collection, namely interviews and literary review.

4.2 Sampling

The data collection in this study consists of interviews of people who have knowledge about nuclear power as an energy source and the regulatory regime in Norway, either because they are scholars themselves or by working in the energy or regulatory sector. They were interviewed because they were deemed to have knowledge the author could not find in the literature, which is a strategic sampling (Dalland, 2022, p. 79). One advantage to the strategic sampling is that I

received information that was highly relevant to the thesis, seeing that it was difficult to find articles about Norway in this context. A disadvantage on the other hand, is that this type of sampling excluded, to a large degree, opponents of nuclear power and lay people.

4.3 Sample size

It is unnecessary to have a large sample size when conducting qualitative research because of the richness of data (Hennink et al., 2020, p. 107). The sample size of participants to answer questions about the Norwegian regulatory regime for NP and how, or if, diversifying the energy mix with NP is possible is "guided by the adequacy of data" (Hennink et al., 2020, p. 108). It was deemed that eight participants were an adequate number. See Table 2 below for sample size and coding.

Table 2. Sample size and coding of interviewees

Informant	**Organization**	**Code**
Informant 1	Independent research foundation	I1
Informant 2	Interest organization	I2
Informant 3	Limited liability company	I3
Informant 4	Electricity supplier	I4
Informant 5	Scientist	I5
Informant 6	Energy company	I6
Informant 7	Scientist	I7
Informant 8	Regulatory body	I8

4.4 Recruiting

I initially contacted people I had seen in the public debate and found their contact information publicly available online. This led to the use of the snowball method, which is a method where I asked the participants if they knew anyone that could be of relevance for this study (Hennink et al., 2020, p. 104). All of the interviewees were contacted through mail and were

given information about the project beforehand so they could take an informed decision. All interviewees were given a thank you note, and many wanted to read the thesis when it was finished.

Though the snowball method might propose homogeneity (Hennink et al., 2020, p. 104), this was avoided to a degree, because the informant who gave the author two additional interviews declined participating in this thesis themselves.

4.5 Data collection strategies

4.5.1 Literature review

"A literature review can be described as a more or less systematic way of collecting and synthesizing previous research" (Snyder, 2019). A literature review can have several purposes, depending on the task at hand and what emphasis the researcher gives it. According to Ridley (2012, p. 24) some of these purposes can be to provide a historical background, it can give an overview of the current context, or it can provide evidence for research gaps that are justifying your research. The purpose of a literature review in this thesis is to contextualize the current discourse regarding the regulatory regime and nuclear power in internationally and in Norway, while at the same time filling a research gap about the regulatory frameworks that are needed to implement nuclear power to see if existing regimes and regulations in Norway are mature enough.

Secondary literature are documents, government reports, and organizational reports that are available for everyone (Lynggaard, 2012, p. 155; Blaikie & Priest, 2019, p. 178), such as government NOU and white papers. Tertiary literature is also available for everyone, but it is literature that is produced after an event or situation, such as journal articles and academic books (Lynggaard, 2012, p. 156; Blaikie & Priest, 2019, p. 178). For the purpose of this thesis, a plethora of articles, government reports, organizational reports, and book contributions about energy security, nuclear power, and the Norwegian energy mix will be used as a basis for the literature review.

See Table 3 below for an overview of chosen documents that makes part of the basis for the empirical chapter, together with findings in the interviews. Further discussion will be found in chapter 5 *Empirical Findings*.

Table 3. Articles used in the literature review.

Category	**Authors**	**Reference**
Nuclear power in Norway	Andersen, 1980; Sæle & Kristiansen, 2023	Andersen, S. S. (1980). Conflict over New Technology: The Case of Nuclear Power Planning in Norway 1972-74. *Acta Sociologica, 23*(4), 297-310. https://www.jstor.org/stable/4200659 Sæle, S. O. & Kristiansen, H. (2023). *Fra ord til handling- en innledende mulighetsstudie om kjernekraft i Norge*. Norsk Kjernekraft.
Regulatory articles	DSA, 2019; IAEA, 2015; IAEA, 2019; Matthews & Park, 2013; Williams, 2018; Wahlström, 2007	DSA (2019). IRRS ARM Summary Report (1/2019). Norwegian Radiation and Nuclear Safety Auhtority. Oslo. Retrieved from https://dsa.no/publikasjoner/_/attachment/inline/0f5654aa-61d1-4f0e-854a-ddbb074ed396:93d360c0de99a7d7a7427689c70fb28a5d883c31/DSA%20report%2006-2019%20IRRS.pdf IAEA (2015). Milestones in the Development of a National Infrastructure for Nuclear Power. IAEA Nuclear Energy Series (No. NG-G-3.1 (Rev. 1). https://doi.org/10.61092/iaea.hff3-zuam IAEA (2019). Integrated Regulatory Review Service (IRRS) Mission to Kingdom of Norway (04/2019). Retrieved from https://www.iaea.org/sites/default/files/documents/review-missions/irrs_norway_2019.pdf Matthews, T. P. & Park, E. K. (2013). Regulatory independence and accountability: a survey of international nuclear regulatory regimes. *Int. J. Nuclear Law, 4*(1), 5-19. https://doi.org/10.1504/IJNUCL.2013.052041

		Williams, L. G (2018). Nuclear Safety and nuclear security regulatory challenges facing a country embarking on a nuclear power programme. *Journal of World Energy Law and Business (0),* 1-20. doi: 10.1093/jwelb/jwy034 Wahlström, B. (2007). Reflections on regulatory oversight of nuclear power plants. *Int. J. Nuclear Law*, *1*(4), 344-377. https://doi.org/10.1504/IJNUCL.2007.014805
Regulatory failures	Wang, Chen & yi-Chong, 2013	Wang, Q., Chen, X. & Yi-chong, X. (2013). Accident like the Fukushima unlikely in a country with effective nuclear regulation: Literature review and proposed guidelines. *Renewable and Sustainable Energy Reviews*, *17*, 126-146. http://dx.doi.org/10.1016/j.rser.2012.09.012
Policy	Batini et al., 2023; Heffron, 2013; Mostue et al., 2022;	Batini, N., Serio, M. D., Fragetta, M., Melina, G. & Waldron, A. (2023). IMF Working Paper. Building Back Better: How Big Are Green Spending Multipliers? *IMF eLIBRARY*, *2021*(87), 1-47. https://doi.org/10.5089/9781513574462.001 Heffron, R. J. (2013). Nuclear new build in the United States 1990-2010: A three state analysis. *Technological Forecasting & Social Change*, *80*, 876-892. Mostue, L., Taule, H., Borgen, S. T. & Jebsen, S. H. (2022). The Energy21: Strategy 2022: National strategy for research, development and commercialization of new climate-friendly energy technologies. Energi21. Oslo. Retrieved from https://www.energi21.no/siteassets/energi21-strategy-2022-en-lr-2.pdf
Justice	Ash, 2010; Carley et al., 2020	Ash, J. (2010). New Nuclear Energy, Risk, and Justice: Regulatory Strategies for an Era of Limited Trust. *Politics & Policy*, *38*(2), 255-284. https://doi.org/10.1111/j.1747-1346.2010.00237.x

		Carley, S., Konisky, D. M., Atiq, Z. & Land, N. (2020). Energy infrastructure, NIMBYism, and public opinion: a systematic literature review of three decades of empirical survey literature. *Environmental Research Letters, 15*, 1-16. https://doi.org/10.1088/1748-9326/ab875d

4.5.2 Interviews

This study has conducted in total eight interviews with eight informants, with a focus on the main themes of: energy security, nuclear power, the Norwegian energy system, and energy justice. The interviews were semi-structured, which is defined as "an interview with the *purpose* of obtaining *descriptions* of the *life world* of the interviewee in order to *interpret the meaning* of the described phenomena" (Brinkmann, 2018, p. 581).

I used an interview guide as a help to navigate both myself and the objects towards themes that were relevant for this thesis (see Appendix A). The interview guide was not used thoroughly for all interviews, because the informants had differing knowledge about the set questions (Brinkmann & Tanggaard, 2012). The guide consisted nevertheless of the main themes that were of help if the informants needed guidance to the right subject. The interviews were conducted in the period between February-April 2024 via Teams because of the geographic location of the objects and the author. This could pose challenges because of the lack of interpersonal contact and the weakening of conversational flexibility (Brinkmann, 2018, p. 578), but the experience was nevertheless positive. They lasted between 30 minutes to 1.5 hour, and they were recorded using an app that transcribed the material with the use of an AI tool.

4.6 Data analysis

An analysis is a way of breaking up information into smaller parts (Tanggaard & Brinkmann, 2012, p. 37), and in some ways you fragment the information into more manageable information. One way to do this is to code the information. Coding allows the researcher to identify issues raised by participants (Hennink et al., 2020, p. 218), or the codes can be categorized as themes that are found throughout the data material (Dusi & Stevens, 2023, p. 298). This study has chosen a thematic analysis (Boyatzis, 1998), because of the problem statement and research questions. "A theme is a pattern found in the information that at a minimum describes and organizes the possible observations" (Boyatzis, 1998, p. 4), and themes can be generated inductively, deductively or as a combination.

Thematic analysis (TA) is a method used to see, encode, and interpret patterns (or themes) in a data set, and this is divided into four stages: 1) seeing themes, 2) encoding themes, 3) developing codes, and 4) analysis (Dusi & Stevens, 2023, p. 297). Part 4, the analysis, will not be discussed further in this chapter, but be discussed at length in chapter 5 and 6. There are different strategies one can use for code-development (Boyatzis, 1998, p. 29), and the most relevant strategy for this study is a *theory-driven strategy*. The theory-driven strategy creates codes based on assumptions and hypotheses from a theory (Dusi & Stevens, 2023, p. 298). In this case the codes are derived from risk governance and energy justice, with some sub-themes included.

Each interview was transcribed shortly after they were conducted because that is when the information is latent for the researcher (Tanggaard & Brinkmann, 2012, p. 34). I did not focus on irony or tone of voice when transcribing the interviews, though some meaning might be lost because of this. The initial transcription happened by using an AI tool provided by UiT and UiO, and I thoroughly revised them afterwards, because the AI misunderstood many dialects. Furthermore, I colored what I said in the interviews, making it easier to differentiate between me and the informant.

The next step after transcription is coding the information (Dusi & Stevens, 2023). Coding involves interpretation, i.e. interpreting the meaning of the text/information (Hennink et al., 2020, p. 225; Boyatzis, 1998, p. 30). The information was first color-coded to an ascribed theme, to be able to categorize them to the different sub-themes. Thereafter, I derived the quotations that were useful to answer the RQs.

The identified themes are derived from risk governance, namely pre-assessment and risk communication, and energy justice. Within risk governance I chose to use pre-assessment and risk communication as main themes. Within pre-assessment I used *regulation*, *management*, *risk*, and *security* as sub-themes. The sub-themes for risk communication are *competency*, *transparency*, and *stakeholders*. The sub-themes for energy justice are distributional, procedural, and recognition justice. Distributional justice sub-themes are *distribution of benefits and ills*, *access to political power*, and *location*. Procedural justice sub-themes are *policy design*, *public participation*, *local acceptance*, *conflict*, and *inclusion*. Lastly, recognition justice´s sub-themes are *social and historical context* and *discrimination*.

4.7 Ethical considerations

Before approaching potential interview objects, I sent an application to the Norwegian Agency for Shared Services in Education and Research (SIKT) (see Appendix B), because the project entails gaining personal information. Ethics is important to consider when conducting a study. Anonymity is of great importance in qualitative studies because they seek to understand perceptions and people's beliefs (Hennink et al., 2020, p. 71). To mitigate this, the interviewees were provided with a background on the project beforehand, as well as information about their anonymity and right to withdraw their consent at any point in the process (see Appendix C). To ensure that consent was present I asked to receive a signed version of the consent letter before conducting the interviews, which ensured that the participation was voluntary (Hennink et al., 2020, p. 76). All information that could identify the persons was anonymized after the interviews were conducted.

4.8 Quality of the research

4.8.1 Validity

Validity is the accuracy and truthfulness of the scientific findings, and it encompasses internal and external validity (Brink, 1993, p. 35). Internal validity refers to whether or not the research findings reflect or represent reality, while external validity concerns the degree to which the internal representations are applicable to other groups (Brink, 1993), and the generalizability of the findings (McDermott, 2012, p. 34). To enhance the internal validity I used triangulation, which is the use of two or more data sources, methods, theoretical perspectives, or approaches to the analysis (Brink, 1993, p. 37). Qualitative studies do not necessarily seek to be generalizable for other cases, but it is not unthinkable that some of the findings in this study might be transferable to other studies or to real life.

This study used semi-structured interviews and literature review as data collection methods, which are deemed to be suitable because of the amount of information I was able to gather through these. To ensure that the questions were understandable I conducted a test interview, and gained feedback about changes that were needed and what parts that worked. The interviews made it possible to extract information directly from people with extensive knowledge, while at the same time making room for additional questions and control of my understanding as to what they said.

4.8.2 Reliability

Reliability refers to the degree of consistency, and the stability of findings, in other words, how the research can be replicated by another researcher (Silverman, 2020, p. 89). Reliability can be enhanced by describing how the data was collected and approached, i.e. by making the research process transparent for others. The choice of a thematic analysis can therefore enhance the reliability of this study because the research process is clearly formulated, and themes are derived from existing theories.

The researcher poses one of the biggest risks to reliability in qualitative research because it is the researcher who gathers and analyzes the data (Brink, 1993). Transcribing the interviews enhances reliability, but the issue of translation is prevalent. The interviews were conducted in Norwegian and translated to English by me, thus there might be a loss of contextual meaning. This was alleviated through citation checks by the informants and a thorough review of the language.

A theory-driven approach can result in a lower interrater reliability (Boyatzis, 1998, p. 30). Interrater reliability involves giving analysts the same data used in your research and having them analyze the data according to categories that are agreed upon (Silverman, 2020, p. 92). The reason why this type of reliability might be weakened when using a theory-driven approach is because the code might be influenced by the researcher's bias, and it is usually further away from the raw data than with other approaches.

4.9 Limitations

The empirical collection of data is mainly based on interviews of relevant actors. Interview objects were chosen based on both the snowball method and the author's own knowledge of experts on the energy field. By emailing certain experts the author was given names of other people that could be relevant to ask. Because of this, there might be some subjectivity present in the data collection, seeing that some of the interview objects knew each other and might talk together about the interviews.

Another limitation is the fact that there were only eight people who accepted to be interviewed. This might not be sufficient from a representative viewpoint, though research does not agree on a "golden number" of informants (Hennink et al, 2020, p. 108). Furthermore, because some of the interviewees were selected based on suggestions from other people one cannot rule out selection bias (Hennink et al., 2020, p. 111). Some of the interviewees also have their own

agenda according to their work, such as working towards establishing NPP in Norway. This will be mitigated by comparing facts from those interviews with objective research and numbers in peer-reviewed articles, when possible.

5 Empirical findings

In this chapter I will present the findings from the analysis of the collected data. First, I will present a brief overview of governmental agencies that are relevant for the nuclear power regime. Thereafter, I will present the empirical findings regarding the Norwegian regulatory regime, before presenting possible routes to diversifying the Norwegian energy mix. The informants are written in parentheses and quotes from them will be in cursive. The chapter is structured after the thesis' research questions (RQs). RQ1 looks at which procedures and regulations are needed in Norway to implement nuclear power (NP). RQ2 seeks to investigate how Norway can improve its procedures when diversifying its energy mix.

5.1 Governmental structure

The regulatory regime in Norway for nuclear power is quite extensive because they have had nuclear research reactors since the 1950s (Andersen, 1980), and thus Norway has established a certain divide between governmental agencies and ministries. Figure 3 below is an overview showing which governmental body and agency that are relevant if Norway were to implement nuclear power. Furthermore, this shows the current structure and divide between responsibilities.

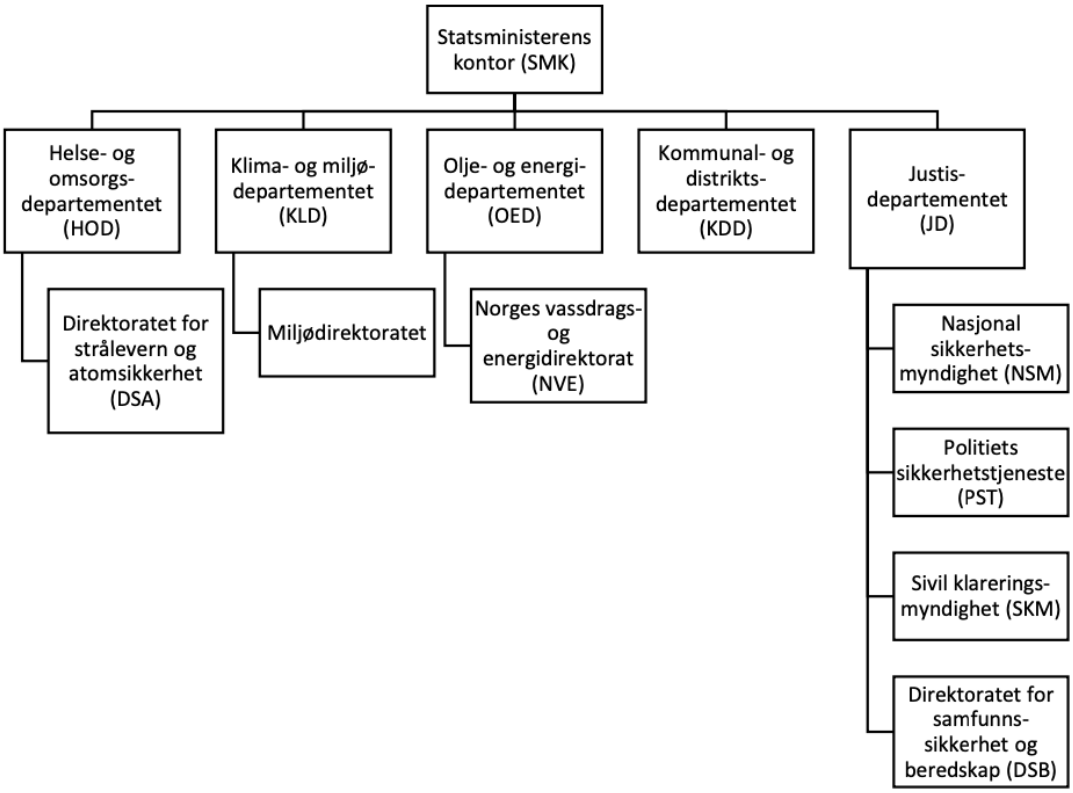

Figure 3. Overview of relevant governmental bodies (Norsk Kjernekraft AS, 2023, p. 58)

5.2 Regulatory hurdles in the Norwegian regulatory regime

Several differing viewpoints has been uncovered from the interviews regarding the present regulatory framework in Norway. The interviewees had different opinions as to how the regulatory framework could be enhanced and used, and whether it is possible to implement regulations directly from foreign countries.

5.2.1 Organizational structure

The question that becomes prevalent if Norway were to implement nuclear power in the energy mix is the organizational setup for the regulatory bodies and those who perform audits on the plants, as stated by I1, I2, I5 and I8. Informant 1 stated "*what kind of mandate should the authorities get? This depends on factors such as [environmental] footprints and waste [from the NPP] etc. It all depends what factors are deemed most important".* What mandate the regulatory authorities have and what mandate private organizations and the owner of the plant has, differs from country to country, but there are guidelines and expectations given from the IAEA (Williams, 2018).

There are many different infrastructural elements that need to be in place before a country starts incorporating nuclear energy into their energy mix. The IAEA names three organizations that need to be involved: the government, the owner of the plant, and the regulatory body (IAEA, 2015, p. 6). I2 notes that Norway has a regulatory body, DSA, and that it would be best if they continue "*overseeing nuclear safety at, and around, NPPs […] but it is first and foremost the owner of the plant who will be responsible for the safety of the plant".* IAEA further note that it is important to have independent regulatory bodies to ensure an effective decision-making.

"The IAEA estimates that the time it takes from a country starts investigating nuclear power until the first NPP is in operation, is around 10-15years" (I2), and this might be because of all the processes and regulations that needs to be in place before NPP can be implemented. One way to mitigate this and to learn from others, while also ensuring a greater influx of power to Norway is by "*investing in nuclear power in Sweden, to give us [Norway] breathing room for 10 years or so, so that we can use those years to build our own regime for it"* (I5). This is also a suggestion from I4, who stated that it would be easier in Sweden because they already have an infrastructure in place, both regulatory and political.

5.2.2 National position/opposition

I3 proposed that "*Norway needs to make a comprehensive plan in terms of the type of country we want to be, what developments do we want to partake in… and how long do we want to lean on oil"*. Such a plan can be found in the strategy document Energi21, which is the government's "national strategy for research, development and commercialization of new climate-friendly energy technology" (Energi21, 2022). This document does not however, mention nuclear power or energy as a possibility. I8 further elaborates on this by stating that there are no one working with new nuclear technology today in the regulatory authorities, but that they [the organization] regularly receive questions regarding what the possibilities for starting a nuclear power plant are (I8). Furthermore, I8 emphasized that there needs to be a political decision in place, and that "*the rules are such that it is the King in Council who can grant a license"*.

IAEA highlights 19 infrastructure issues that need to be addressed before a country can embark on a nuclear energy journey (IAEA, 2015). The first issue is that of national position, or opposition. Governmental support is pivotal to the success of a nuclear program (IAEA, 2015, p. 10-11). I2 stated that *the biggest obstacle to nuclear power in Norway is politics, or national opposition, because no one can build nuclear power without the government wanting it to happen*. This view is shared by I1, I3, I5, and I7. They explained the government's stance on

implementing NP as a barrier, and I5 explained that "*we have to apply scientific best practice"*, pointing to the need for national positions based on science and not emotions.

I3 explained that the political opposition towards nuclear power is because it poses a great risk, both politically and regulatory. The informant explained this with the fact that there is no decision in Parliament, and therefore it poses a big risk. I6 concurrently mentioned that there must be *"…a reasonable boundary between what <u>needs to be</u> determined nationally and what can <u>be</u> determined locally".* The informant stated that municipalities in many cases has been given decision-making power that might not always be appropriate, thus making a divide between what the national government decide and what the municipalities decide.

Additionally, I1 and I5 believe that it would be possible to establish a nuclear power in Norway within the next ten years, by looking at both the technological possibilities, the regulatory regime, and operational competency, but that the political willingness is stopping it from happening. This is prevalent in the media and public debate but can also be seen in applications for research funds for nuclear power. [2]

5.2.3 Enhancing energy security

Most of the informants (I1, I2, I3, I4, I5, I6 and I8) define energy security as power being available at all times when needed, and that the energy supply is tightly connected with the energy security. They thus see a nexus between the supply side and the security side of energy, which is in line with how the Government views energy security (NOU 2023:3). I3 explained that his definition of energy security also included *"…we should be sure that we have power available at all times regardless of temperature and weather".* That the power is available regardless of temperature and weather points to the wish for more energy sources that are not intermittent. I3 delved deeper into this by stating *"that is the problem with intermittent energy sources, because you get power when it is windy or raining, you do not necessarily get it when you need it".* I7 on the other hand, defined energy security like this:

> *"Energy security is, I might emphasize, if you have a more diversified energy mix, you have more energy security. If you have a certain proportion of weather-independent power, you*

[2] One example is an article written by two researchers from NTNU, where the Research Council declined their and several other people´s application (https://www.altinget.no/artikkel/ntnu-forskere-kjernekraftkompetanse-er-ikke-nok-for-forskningsraadet).

have energy security… Weather-independent power does not need to be nuclear, but that´s often what we´re talking about in this context".

The connection with the European market with the undersea cables to Germany and the UK has created a lot of debate in Norway, and the informants had differing views regarding if the cables were enhancing or weakening the Norwegian energy security. I7´s opinion on this was that the cables had been presented as a way of enhancing Norwegian energy security, but that this argument has been weakened because of the increasing electricity prices. I7 continued the argument with a hypothesis that the cables were approved for import- and economic reasons, but that energy security was used as a scapegoat to people´s approval. It is important to note that these cables have become a controversial and very political topic.

I3 had a different opinion, stating that *"in my mind, foreign cables help increase energy security because they cover some weaknesses in our power grid"*. The informant explained this with the fact that Norway has a positive power balance, but not always, so the cables cover the electricity and power in the hours that our power system is insufficient. In conclusion, the informant stated that *"our electricity usage pattern is like an inverted bathtub, our usage swings almost perfectly countercyclically with the solar energy production"* (I3).

Drawing a nexus between energy security and nuclear power, I1 asked whether a nuclear accident can be seen as a regional industrial accident or a global accident. *"Can a nuclear accident be seen as a regional industrial accident? Some may argue yes, but I don´t think it will be seen as such. The nuclear power industry sees it as a global one"* (I1). The explanation for this reasoning entails both the focus on safety and security in the nuclear industry, and that there are many demands on testing the systems before they are used. I2 believe that energy security should be handled differently depending on how long one seeks to enhance it. *"If you think about energy security in a 100-year perspective then you need to include sustainability"* (I2), explaining that this is also a political question as with everything else. The informant also stated that he believes people are willing to sacrifice sustainability to get enough power and enhance energy security, namely for their own survival if things were to go that far.

I2 nevertheless highlighted the importance of an energy transition, and that *"the green shift is about replacing fossil fuels with something that emits less CO2, and it must be done with something that is reliable. It is only nuclear power that is the realistic option*". The informant

further believes that there are stronger incentives to build energy security now because of the geopolitical situation, and because energy is seen as a commodity that one buys.

5.2.4 Regulatory regime

Many sectors in Norway emits radiation in some form, such as the research reactors in Halden and Kjeller, nuclear medicine, and the petroleum industry (DSA, 2019, p. 7). I1, I2, I3, I5 and I7 all argue that Norway has the regulatory framework that is needed to implement NP because of the existing laws and regulations that are used for these sectors. I6 on the other hand, said that "*there has been a far too optimistic view of what is needed in terms of structures around nuclear power to make it happen in Norway, and it has been far too optimistic in terms of technology and costs"* (I6).

"The Act on Nuclear Energy Activities (NE Act) was passed in 1972, and it was made because it was thought that Norway was going to implement nuclear power. But it hasn´t been further developed, it hasn´t kept up with time either, because it was decided quite early that Norway shouldn´t build nuclear power. So those of us who administer the law see that it has a lot of holes" (I8).

The NE Act (1972, §§ 1-59) was made, as stated by I8, for the regulation of nuclear power plants and adjacent facilities but is now relevant for the transportation and deposition of radioactive waste. I8 further explains that they believe the regulatory regime requires a thorough revision process to ensure a good regulatory regime to adhere to before Norway can implement NP. This contrasts with what I1, I2, I3, I5 and I7 believe.

Though many believed Norway has a good regulatory regime for the handling of nuclear power and its facilities, they had several suggestions as to how it could be enhanced. I4 suggested that Norway look towards Sweden, Finland, or France to learn about the different possibilities for how one can establish NPP and incorporate laws and regulations from them. I5 first and foremost believe that "*the Norwegian bureaucracy in many ways has implemented laws and regulations from the EU without realizing what they´ve done, and that´s allowed us to have a good regulatory regime"* (I5). One example I5 presents to further enhance the regulatory regime is to join the G7 and IAEA in aligning the regulatory framework, so that there is one framework for all participatory countries (I5).

Additionally, I5 present the possibility of looking towards the United Arab Emirates, who have built a regulatory regime and NPP in 12 years. I8 contradicts this by saying that "*it is often*

referred to the UAE and that they´ve managed to initiate and build NP in just a few years. But there is a sheikh sitting on the top, there´s not a lot of democratic processes there" (I8). I8 further elaborated that it might be difficult to implement other country's regulations because they are fragmented and must be adapted to the Norwegian regulations. Thus, it requires more thorough work than just incorporation.

Because NPPs are associated with, and entail a great deal of risk, it is important that different perspectives of risk are considered in the process. Some of the informants pointed out that risk perception is subjective, and hence should be a part of the nuclear debate (I1 and I8). I1 pointed out that *"risk perception is super important"*, but also that societal developments should be based on established knowledge, and not based on a simple concept of fear (I1). It is especially important for the regulatory bodies to listen to people's concern on risk, and I8 emphasize that *"we take perceived risk seriously, and it is up to each individual what risk you accept"* (I8). I5 stated that *"the level of risk that has been presented in media over the years has been a lot of nonsense"* (I5), thus believing that people´s risk perception often is shaped by misinformation because the risks associated with NPPs might be difficult to present in an easy and understandable way.

5.2.5 Regulation and competency

Competency is a regulatory requirement for those who administer the regulations and the NPPs. Some of the informants (I1 and I7) believed there is no lack of competency on NPPs, security, safety, and regulation in Norway. *"Competence and safety are not a problem in Norway"* (I1). The informant refers to the notion that Norway must build their knowledge base from scratch. I7 believes that:

> *"The argument about lack of competency in Norway is kind of a myth that has managed to take root. Take IFE for example, who announced in 2022 that they had developed an SMR [small modular reactor] simulator. Their ambition is to compete to get those who will work at SMRs when they are built in Europe, so that IFE can train them in their simulators"* (I7).

Furthermore, both I1, I2, and I7 state there are synergies from oil and gas, and that much of competence from the petroleum sector can be transferred to NPPs. I7 explains this by saying *"… a NPP is very viable with oil and gas. NPP is only 5% nuclear physics, and the rest is engineering and complex systems, pump valves, turbines, and generators"* (I7). I2 explained that the competency from oil and gas mainly comes from the strong safety culture and

management. I5 thought that it would be easier to rebuild the academic communities that have been lost after the design of an NPP is finished, because you need to know how many people that are needed for the plant and because there are over 80 different designs for an SMR (small modular reactor).

I3, I4 and I8 explicitly stated they do not believe there are personnel that are competent enough to manage the regulation and operation of NP in Norway. I6 had no opinions regarding this because of the company's stance on NP, and thus saw it as irrelevant. I1, I2, I5, and I7 believe that there are competent personnel within the Norwegian borders, but to a varying degree. I1 and I2 stated that there are enough personnel for the safety, security, and operation of a power plant, and as I1 put it: *"This is not new for us. The experience we and the Petroleum Safety Authority have with supervisions and audits of industrial systems and human factors… we have a strong tradition for that in Norway"*.

I2 further noted that *"it is important to note that, formally speaking, we have a nuclear preparedness system in Norway, which includes the municipalities"*. I7 on the other hand emphasized that *"if it´s true that it takes time to build competency then there is no reason to not do anything now. That is a reason to perhaps acquire more knowledge and investigate even more to get ready to make the choice"*. The informant used this as a counterargument for the notion that Norway should wait before they start thinking about nuclear power in Norway.

I8 mentioned that they are contacted by organizations and municipalities regarding possible new nuclear power, but they are not trained to answer those kinds of questions. Furthermore, informant 8 estimates that Norway and its regulatory authority needs an additional 100-150 new positions to be able to meet the demand of a potential new regulatory framework, which is a doubling of today's work force. They came up with that number by looking at Sweden and Finland, two countries with an extensive regulatory body. This statement regarding the need to look outside Norway's borders to gain competency and enough people is backed by I3 and I4.

5.2.6 Communication

«We want the debate to be enlightened and fact-based" (I8). There are a plethora of stakeholders and actors in the nuclear debate in Norway, which all seek to communicate how NPPs work, the risks related to them, and what NPPs could mean for the Norwegian energy system. One of the biggest actors per date is Norsk Kjernekraft AS, who seek to conduct impact

assessments and communicate the results from these to the public and potential stakeholders.[3] According to I1, *"The way they [Norsk Kjernekraft] are active in media leads to a debate and public education in a completely different way than if a neutral scientist were to say their opinions".* Informant 1 further explained this thought by referencing how lay people receive information, and that information might be easier to understand when spoken in "normal language", and not in "research language".

Informant 6 argued that *"there are huge gaps in how nuclear power is presented, especially on the cost side"*. One example that was pointed out by many of the informants (I1, I2, I5, I7) was the report published by Rystad Energy in 2023, which sparked a debate surrounding cost calculations and what some meant was cherry picking which facts one use in the debate (Emblemsvåg, 2024; Kinserdal, 2024). Further, I2 expressed that *"it is difficult to communicate around the safety of waste management for instance, because it is easy to trivialize it by saying nuclear power is not the only power source that produces waste"*. It is nevertheless asserted by I8 that *"the most important thing is that you get factual information and can communicate about the risks we are talking about, and what consequences it [nuclear power] may have".* The communication regarding facts and risks towards NPPs seems to be difficult and depends on both the communicator and those who are on the receiving end.

5.2.7 Summary of RQ1

The main findings from RQ1 can be summarized to be that there is a bigger consensus amongst the informants that Norway has a good regulatory regime to establish new nuclear power. It is nevertheless important to note that one of the informants has an insight into the regulatory authority that none of the informants has, and that informant stated that there is a lack of a robust regulatory framework, in addition to personnel to handle the framework. Additionally, there is no agreement as to how the regulatory authority and its organizational setup should look like. The informants working in the industry and interest organizations have a different opinion than those working with the regulations. Some of them (I1, I2, I5, I7) believe that the organizational chart pictured in Figure 4 is enough.

Norway has ratified and incorporated much of the international frameworks and regulations that is necessary according to the IAEA, but work needs to be done to modernize and enhance

[3] Info found on their website (https://www.norskkjernekraft.com/Om/).

the Norwegian regulations. This work can take several years. All the informants agree that the biggest obstacle for implementing nuclear power in Norway is political willingness. A majority of the informants believe that if, or when, the Parliament gives a green light for nuclear power, a lot of businesses will apply and start the licensing process. This is argued because of the big interest in nuclear power that has appeared in the last years.

5.3 Including justice in the process

There are several routes a country can take to diversify its energy mix, and this is decided by the Parliament and its politicians. There are nevertheless a few aspects that are important to focus on when investigating possible routes, and the procedures that have to take place. This section will thus investigate what factors that are deemed important by the informants, and it will be further complemented in the discussion chapter with literature.

5.3.1 Possible diversifying routes

Several Government-appointed committees, governmental agencies, and independent reports has pointed towards the need for more power production to ensure that the future energy demand is met, additionally pointing to potential sources for energy production (NOU 2023:3; NOU 2023:17; Statnett, 2023; Rystad Energy, 2023). The debate around nuclear power is inflamed and object to differing viewpoints.

I6 elaborates on this in view of sustainability and the Sustainable Development Goals (SDGs):

> *"Nuclear power is necessary in a European or global perspective to cope with climate change. It is almost impossible to imagine achieving the 2050 goals [SDGs] without a significant element of nuclear power, and nuclear power makes sense in the countries and regions where you don´t have the fantastic renewable sources that we have in Norway"* (I6).

The informant (6) thus believes that nuclear power is necessary to enhance European energy security, but in the Norwegian context one should rather continue building renewable energy sources (i.e. wind, hydro and photovoltaic). Informant 6 further argued that Norway should use their comparative advantages as a renewable nation and continue building more renewable energy, and that onshore wind is cheaper than NP, henceforth more worth building. I7 on the other hand, expressed *"I wish all emission-free energy sources could compete on equal terms"*, referring to the objective that nuclear power is disregarded as a possible energy source by the Government.

"The energy mix in Norway if we look at the electricity system is 90% hydropower, around 8% wind, and a couple percent bio- and waste incineration. It is renewable today, but less than half of the energy consumption that is consumed, is on the grid" (I2). The informant refers to the amount of renewable energy that is used in the different sectors of society, and the type of energy source that generate electricity and power[4]. I4 believes that *"... nuclear power is the most realistic choice for diversification. But we´re talking closer to 20 years than 10 years, because it takes time to establish what we need before we start thinking about building it"*. The informant further expressed that he believes that neither Europe nor Norway can achieve climate-emission-free energy production without nuclear power, and that it will be an essential part of the future energy mix.

"Obviously if we have all the players on the pitch, that´s an advantage. If you don´t have 11 players on the field, there will be more focus and resources towards the 10 players that are on the field. I think we´re better served by having a full team" (I7). The informant expresses a concern regarding nuclear power being disregarded by Norway, because they believe that NP can be a complementary energy resource to build a robust energy mix. I1 and I2 argued that NP could be used as baseload, while hydro power is used as load following[5]. Coal-fired plants are usually used as baseload because it can run continuously, but because of the current energy transition there is a need for a renewable or low-emission baseload in the energy system.

5.3.2 Distribution and location

One important aspect to consider when going through an energy transition is the impacts the transition has on society and lay people. The impacts that are analyzed here are namely the distribution of benefits and ills, and location of the power plants. *"Wind power locations are often in untouched nature, which means you are industrializing nature unnecessarily"* (I1). Informant 1 expresses a concern about the use of land for new wind parks and emphasizes that NPPs would be placed in already industrialized areas, such as nearby industrial facilities or farmland. I1 believes that there would be a more proportionate distribution of benefits and ills by building NPPs instead of wind parks. This is a view shared by I3: *"The benefits of wind*

[4] This will not be discussed further, but it is of relevance as information about the energy system and the Norwegian energy mix.

[5] Base load power is the minimum amount of power needed on the grid at any time to meet the daily needs, while load following are energy sources that meet the fluctuating needs (University of Calgary, w.y.).

power have primarily been the profits of a few landowners, so there are few benefits [to the community] compared to the inconvenience that affects many people". Informant 3 justifies this reasoning with the notion that disadvantages with wind parks are local, for instance flickering, noise, and that they are not aesthetically pleasing.

Additionally, I2 emphasize that there are several factors, i.e. no risk for floods, earthquakes, or landslides, that needs to be checked out in an impact assessment before one can decide where a NPP can be placed. I2 further states that *"… you have to avoid cultural heritages, rare animal species, and so on".* One of the biggest contributors to the distribution of benefits is argued to be the number of workplaces an SMR creates. Both I2 and I5 argue that it is an estimated 75-100 permanent workplaces for an SMR in operation, numbers that are derived from already existing power plants and calculations done by themself. I5 explains that *"additionally, you´ll have jobs that are created for the fuel management side and the whole life cycle".* Because of the permanent jobs a NPP creates, I2 argues that *"there are many municipalities in Norway where such a plant would be the largest employer".*

"To me, Fukushima is an example of there being an argument <u>for</u> nuclear power rather than against. It´s almost worst-case, because you have a plant that gets a full meltdown, and <u>nothing</u> escapes from the plant. In terms of risk, you have to look hard to find a better case than Fukushima" (I4).

Informant 1 supports this thought. I1 explains this with the fact that no one died after the Fukushima accident, but that it also has led to an economic catastrophe for Japan and the agricultural sector in Fukushima. *"Statistically, if you look at accidents and such, nuclear power is less dangerous than hydro power, and in the same risk category as wind and solar power"* (I1). This argument is followed by I2, who explains that *"the biggest drawback [of the location of a plant] is the psychological impact, and the demanding processes around preparedness, because some people have to live inside an emergency zone".* Informant 2 nevertheless believes that those who have to bear the burden of living near a NPP also receive the greatest benefits, measured in number of jobs, tax money received etc., and that this is the other way around for other energy sources (i.e. wind power).

5.3.3 Participation, acceptance, and conflict

"The most important thing is local acceptance, such as positive municipality and a positive landowner" (I3). Local acceptance is important to gain and consider when discussing any

change to the infrastructural landscape of a country and community (Vasstrøm & Lysgård, 2021), and it is of vital importance to the survival of new energy technologies. I8 explained that *"we place great emphasis on ensuring that affected parties are heard, and this is done through an impact assessment process".* This is also done by conducting public meetings and hearings (I8), to enable a transparent and inclusive process for potential stakeholders and people who may have opinions on the matter.

Many of the examples that were given by the informants were about the processes regarding wind power, arguably because Norway has more wind power and thus has experiences with those processes. One example I3 gave to explain how the processes may be experienced was *"I am a board member of […] who develops wind power, and we have experienced everything from hunger strikes to death threats of different levels. There has been quite a significant opposition to the wind power projects throughout".* This level of resistance can be explained by several different factors, and I6 recognized that:

> *"…the processes for onshore wind have had a lot of weaknesses. A small example is that if a municipal council has accepted one design, but the developers have been allowed to upgrade the technology, leading the development to be of such a nature that you can build bigger than what was planned"* (I6).

Informant 1, I2, I3, and I4 all stated that most energy projects are conflict-ridden. I1 believe it is conflict-ridden because of the use of land and location, while I2 explained that it is often the energy policy that helps create conflict because it in many ways puts a divide between city and the periphery. I1 further stated that *"NIMBY is going to be worse for wind than nuclear power, because people actually want NP".* On the other hand, I3 explained that *"wind has been through "The Valley of Despair", and I believe nuclear power will experience the same in a few years".* It is thus difficult to pinpoint exactly how the acceptance rate for NP will look like, and I5 explains it objectively: *"In nuclear we use consent-based siting, so there is no place that builds nuclear power plants without there being great support locally for it. That is, in Western countries".* This builds the foundation for local acceptance because it is reasonable to believe that the nuclear sector puts great emphasis on inclusion and local acceptance before any plan is materialized. I8 highlighted that *"we as a society have come a long way when it comes to listening to concerned communities and take it into account".*

5.3.4 Summary of RQ2

There seems to be a consensus amongst most of the informants that the processes regarding energy technologies have some shortcomings when looking at a just distribution of benefits and ills, but also inclusion and the level of local acceptance. Most of the experiences and examples thereof are drawn from hydro and wind power processes because Norway has implemented those energy sources. There are still some differences between these processes and the processes connected to nuclear energy because NP is subject to many international standards that provide guidance for how implementation processes should look like. Nevertheless, all informants emphasized that local acceptance is of utmost importance before a municipality or business can start working towards implementing NP.

6 Discussion

This chapter will discuss the empirical findings in light of the study's theoretical framework. The chapter´s structure follows the two research questions, with a third section merging the two first parts. The first sub-chapter will discuss the findings with the use of the risk governance theory and meta-regulation, while the second sub-chapter focuses on energy justice. The third sub-chapter will merge risk governance and energy justice.

6.1 Governance of nuclear power plants

6.1.1 The regulatory regime

There are several steps that needs to be fulfilled before Norway can implement nuclear power as a technology in their energy mix (IAEA, 2019; I2, I3, I4, I8), and these are steps that are important to ensure a secure operation of future nuclear power plants. Within my empirical findings there are differences regarding the necessary changes that must occur in the Norwegian regulatory regime. Some informants are of the opinion that the existing regime is robust enough as it is (I1, I2, I3, I5, I7), while others believe that there must be done changes to the regime for it to robust enough to handle this technology (I4, I6, I8). Also worth mentioning is that the regulatory regime consists of both the regulatory frameworks and the regulatory bodies.

To ensure a secure, safe, and effective regulatory framework it is imperative that the regulatory regime and the personnel working with it are competent and have decision-making power independent from the government (Wang et al., 2013; IAEA, 2015; Williams, 2018). This was expressed by both I3 and I8, who stated that Norway does not have an organization with personnel that can deal with the implementation of nuclear power. Even though DSA is the responsible authority they do not have enough personnel, nor do they have the mandate to deal with the issues of nuclear power. DSA does on the other hand, have insights about what they lack in regard to both personnel and regulations, as shown in their preliminary IRRS report (2019) to the IAEA.

In IAEA's Integrated Regulatory Review Services (IRRS) report (2019) they found that Norway has extensive legal and regulatory frameworks. Examples are the Act on Nuclear Energy Activities (1972, NE Act), Act on Radiation Protection and Use of Radiation (2000, RP Act), and Radiation Protection Regulations (RP Regulations) (IAEA, 2019, p. 9). These regulations are part of the regime that is mentioned by several of the informants (I1-3, I5), from

which they draw the conclusion that Norway has a robust enough regulatory regime. Though some of the informants believe that the existing regulatory framework is enough, it is found in the report from IAEA (2019, p. 8) that Norway lacks a coherent and comprehensive policy document stating the safety strategy, this is also mentioned by DSA (2019, p. 13). A technology as complex as nuclear power, especially regarding the safety, security, and the risks that it encompasses, highlights the importance that such a document is present.

A comprehensive strategy document will help identify the risks present, which is a pivotal part of the pre-assessment in risk governance (Aven & Ren, 2010, p. 57). It is important to mention that it is not only the government and its agencies that decide what constitutes a risk, but also the different stakeholders, academia, and lay people. The document should include all four parts of the pre-assessment, to ensure that the risk governance is adequate. This is in line with some of the aspects that I3, I4, and I8 discussed, where they explained the need for a document that conceptualizes the Norwegian regulatory framework. Additionally it should be noted that the external regulator, DSA, does not experience political support to start working on questions regarding NPPs, because of the lack of political mandate.

Furthermore, it was mentioned by I8 that they believe the current regulatory framework is outdated and need extensive work to encompass the measures needed for the current technological advances on nuclear power, by referring to the NE Act of 1972 which is one of the main acts DSA administers (2019, p. 8). It is reasonable to believe that this act needs refurbishing because of it being 52 years old, and nuclear technology has seen extensive advances since then. Additionally, it has been stated by the IAEA that many of the legal and regulatory frameworks are too diffuse (2019, p. 10), thus enabling the possibilities for less effective and safe regulation.

Because the nuclear sector is subject to ever-evolving technological changes, one proposed regime that could work is the meta-regulation regime. Though this was not directly proposed by any of the informants, several of them argued that the nuclear sector has strong traditions of safety and security regulation. Because meta-regulation entails self-regulation and continuous learning processes, I would argue that meta-regulation is suitable for NPPs and its organizations because it would make the dynamic improvement processes better. One argument for this is the fact that an external regulatory authority could face difficulties in tracking every new information and knowledge that the nuclear sector produces, because of it evolving fast.

Further, it could be argued that the external regulators would get better and more detailed information about the ongoing processes, especially because of the level of competence that is important for the organization that are operating the NPPs. Additionally, the international and national standards that are needed for both internal and external regulations could make it easier to implement self-regulating organizations, thus creating learning processes that could enhance the competency of the external regulators and the regulated organization or industry.

6.1.2 Problem framing: risks, energy, and NPPs

The overall goal for the Government when it comes to the energy sector is ensuring that there is enough power to cover the demand for industry and lay people. It is reasonable to assume that most people agree that it is important to ensure that the Norwegian energy security is robust and that the power industry minimizes the possibilities that a blackout or power shortage occurs. A way of ensuring this is by identifying the potential risks that may occur if Norway does not produce enough power, but also by identifying the risks connected to different energy sources and how this perception of risk is influenced by the values and evidence present in the debate (Aven & Renn, 2010, p. 67). It is already stated by a Governmental report that there is a risk that Norway may go into a power deficit in 2030 (NOU 2023:3), and that Norway must do more to ensure that both the energy security and the security of supply is ensured (NOU 2023:17). This is part of the Governments problem framing, where they have stated that, if Norway does not produce more power or ensures a stabile energy supply, then the risks for potential blackouts and increased electricity prices will be more prevalent. This must furthermore be done with renewable or low-emission energy sources because of the current energy transition, the green shift, and climate goals set by the Government and international organizations.

In the case of problem framing, it is important to understand how the interests, perceptions, and concerns of the stakeholders (i.e. lay people and the industry) may have an impact on the debate. For this thesis it is nuclear power that is the main risk contributor, henceforth it is relevant to include how the society perceives risk concerning NP. Within risk governance it is of the utmost importance that lay people and the society as a whole are included and that their concerns are heard, which was also pointed out by I1 and I8. Though there are certain objective risks connected to the use of NP, i.e. measurable risks such as frequency of nuclear accidents, one can argue that the perceived risk of potential hazards is more important to discuss, because the objective risks are regulated through governmental agencies and the operators of the plants.

Drawing a nexus between the desired goal, more power production and the green shift, one needs to address what the public wants and how they want to achieve future energy production.

A survey conducted by Opinion[6] in February 2023 showed that a majority of Norwegians are for building NP in Norway. They found that there are more people in each age group that are for than against, and that 56% of people under 30 years are positive to NP (Opinion, 2023). Additionally, they found that NP is a bipartisan issue, with voters from almost all the political parties being of part of the yes-group. This is a sign that Norwegians accepts the risks that are connected to NPPs. It was expressed by I5 that people are realizing what NP is and therefore more and more people will be for building it in Norway. One can argue that his beliefs materialized in the mentioned survey. To show a different view, Opinion also asked about opinions on wind power, and found that 46% of Norwegians are positive to building more wind power on land. Wind power is one of the energy sources that the Norwegian government is betting on, but it is also the energy source that has produced many conflicts around the country (Eikeland et al., 2023).

6.1.3 Allocation of management

There are different paths to how a country can organize its regulatory authorities, depending on what country one looks to and the laws and regulations that each country needs to adhere to. DSA is the Norwegian regulatory body responsible for nuclear safety and security, radiation use, and so forth (DSA, 2019, p. 7), and they are assigned tasks on behalf of three ministries: the Ministry of Health and Care Services (HOD), the Ministry of Foreign Affairs (MFA), and the Ministry of Climate and Environment (KDL) (IAEA, 2019, p. 11). In addition to being a regulatory body, the DSA also has a supervisory responsibility. They have many areas of responsibility, and I8 expressed in the interview that DSA is currently not designed to handle new nuclear technology. This is both because the Government has not given them a mandate for it, but also because they lack adequate personnel (I8; DSA, 2019).

It was for instance suggested by I5 that Norway should look to the United Arab Emirates, who have modeled their regulatory authority after US nuclear regulations (I5; Matthew & Park, 2013, p. 7). But because the UAE lacks certain democratic processes, I would argue that

[6] The survey showed that 51% of Norwegians are for nuclear power, while 37% are against it (https://www.opinion.no/innlegg/flertall-for-atomkraft-i-norge).

Norway is better served by looking to other countries when establishing their nuclear regulatory authority. There are countries with nuclear power that Norway is closely linked to that have a more similar democratic governance structure that Norway could draw lessons from. Both Finland and Sweden have NPP and extensive regulatory regimes from which Norway can learn from. Nevertheless, it was explained by I8 that they do not believe there is a need for a bigger bureaucratic agency to tackle new nuclear activities, but rather that the biggest drawback is the need for more people working in the regulatory bodies. This is also underscored in IAEA's report (2019, p. 12), where they found that funds were restrained, and personnel were moved to other regulatory activities.

The reason why it is important to have an effective and independent regulatory body and frameworks, is because it is of vital importance that the agencies overseeing the safety and security of NPP act quickly, should an accident or hazardous event occur. One example of a seemingly inefficient system can be found in Japan, as described by Wang et al. (2013). In their study they argued that the regulatory bodies and lawmakers had developed mutually beneficial relationships with the nuclear operators, where the regulators gained profits from the plants, and the operators received favorable policies (Wang et al., 2013, p. 141). Matthew & Park (2013, p. 8) also argued that parts of Japan's regulatory authority and its independence has been questioned since the Fukushima accident. One can thus argue that less independence could create fewer incentives for identifying potential hazards and risks, henceforth weakening the effective risk governance. The independence of the regulatory body is nevertheless a requirement of the IAEA Safety Standards and the Nuclear Safety Convention (Williams, 2018, p. 5). These findings strengthen the argument about implementing meta-regulation, because it creates the independency needed, in addition to an environment that encourages learning, transparency and trust.

How the management and regulation is allocated is vital for the early warning and monitoring, but equally important is the communication within regulating bodies and out to the public. Adequate communication should entail understandable information to the public, but also that those who communicate risks and hazards are competent and provide factual information (I1, I2, I8; Aven & Renn, 2010, p. 68). The nuclear debate is polarized, and it is currently up to independent actors to communicate about potential risks and hazards regarding NPPs, and this could lead to difficulties in figuring out how one can reach information if a person has little knowledge about the subject beforehand. While DSA is the body that is responsible for

supervising and regulating the nuclear sector, they are too short-staffed to handle responsibilities of communicating to the public as well (I8). I would therefore argue that the Norwegian government should increase funding to the communication section under DSA, that can handle all inquiries and present information to the public, so that those working with regulation and safety can focus on the parts of the nuclear sector that are under their mandate. This is also pointed out by DSA (2019, p. 67), where they emphasize that they need more competent personnel for communicating out to the public.

Additionally, by organizing the regime and allocating procedural rules according to meta-regulation, one could minimize the dangers of intertwined relationships between regulatory agencies, the regulated organization, and politics. Countries embarking on a new nuclear journey should look towards Japan and the coziness between governmental agencies and the nuclear sector, as previously mentioned, to see how they should not set up their regulatory regime and division of power. Rather, Norway has a golden opportunity to learn from Japan's mistakes and mishaps, when shaping their own regime. There are parts of Japan's risk governance and regime that worked, especially because they have a long-standing tradition in the nuclear sector. There is, nevertheless, plenty of research that shows Japan has not always had transparent processes and taken the society into account when shaping their governance and regulatory regimes (Wang & Chen, 2012; de Oliveira & Paleo, 2016; Figueroa, 2016). I would further argue that establishing a self-regulating regime could enhance the independency between agency and organization, thus improving the safety and security of NPPs.

Part of the risk communication within the allocation of communication responsibility is that the public has arrived at a different viewpoint than the government when it comes to NP, even though they have access to the same information. Because people's risk perception will have an impact on how society responds to risk governance (Frewer, 2004, p. 391), it is important that these attitudes are considered when the government forms their policies. Equally important is the fact that society is part of the "monitoring team" for risks and potential hazardous events, thus highlighting how important it is that the communicating body consists of competent personnel and nevertheless has enough personnel to handle the amount of information that is needed to make informed decisions.

6.2 Including justice when diversifying the Norwegian energy mix

When a country wants to diversify its energy mix, i.e. including new technologies from what they already have, they need to incorporate certain processes to ensure that the new policies and legislation are somewhat in line with what society wants. For Norway's sake as a democracy, they should focus more on the justice aspect of policy and energy transition processes. In doing that, Norway could additionally enhance their national security, build trust in governmental bodies and Parliament, while also fulfilling their democratic duties.

6.2.1 Distributing the benefits and ills

An important part that needs to be considered when implementing new technologies, are how the benefits and ills are distributed. This could be measured in both monetary form, areal use, risks, and location of infrastructure. NPPs are, according to I1, considered to have the same risk as wind and solar power (I1), thus it could be argued that they encompass a level of risk that Norway is used to and can handle. On the other hand, the perceived risk for living close to a NPP might be different than that of a wind park. I2 emphasized that the biggest drawback for a NPP might be the psychological drain it could have for people living close to, or inside the emergency safety zone for an NPP.

According to Giordano et al. (2010, p. 169) one can find more positive attitudes towards NP among people who live close to a NPP than in the general public. Though they do not mention anything regarding the psychological drawbacks, this positiveness may be attributed to the number of workplaces that a NPP provides to local communities. This was argued by two of the informants (I2, I5), emphasizing that even though the local communities who are hosts for a NPP are the ones who will experience most of the ills (i.e. living near an NPP, psychological drawbacks), they also experience most of the benefits. Benefits here are workplaces, NPPs using a smaller area than other energy sources, and a boost in the economy with taxation on the industry and taxes from the people working at the plants (Batini et al., 2023, p. 25). I7 further emphasized this argument by stating that nuclear energy penetrates well into the economy, thus having a good impact on gross domestic product (GDP). Batini et al. (2023, p. 36) strengthens this claim by arguing that clean energy (nuclear, wind, solar) has an impact on GDP that is 2-7 times stronger than that of coal, gas, and oil. These economic benefits will in turn have a positive impact on local communities and municipalities, because they could enhance the municipal economies and budgets, thus enhancing possibilities for better schools and activities in rural communities.

Furthermore, it was argued by I7 that NPP can be placed closer to where consumption is, which would help enhance future justice and energy security. One distributional injustice that is prevalent for NP on the other hand, is mentioned by McCauley (2018, p. 59) and is of an international character. NPPs are dependent on uranium, a metal found mostly in Australia, Kazakhstan, and Canada, countries where NP is a big contributor to energy production. Exporting countries of uranium may henceforth be susceptible to manipulation (McCauley, 2018, p. 60) and lose some of their comparative advantages if they decide to incorporate a bigger share of NP in their energy mix. This is something that Norway has to consider and mitigate when discussing NP as a possible energy source, to make sure that there are no human rights violations, a fair business trade, and that one does not destroy nature in the name of sustainable energy production.

6.2.2 Participation, inclusion, and conflict

Public participation is pivotal for the implementation of clean energy and the creation of policy design, because the process depends on the acceptance and agreement between the government and society (Segreto et al., 2020). The decision-making process should involve all stakeholders, namely local communities, businesses, and politicians, because NPPs are large-scale technological installations that have an impact on both national and local security. Concurrently it was mentioned by I1, I2, I3, I4 and I6 that they experience almost all energy projects as conflict-ridden. One conflict that might be more prevalent in the energy debate is the city-periphery-conflict, as mentioned by I2. Rural communities are those who have land that can be used for energy infrastructure, while cities are the ones in greater need of power because of the distribution of people, e.g. that more people live in cities than in the district. Because a democracy is based on a majority-rule, this might lead to a discrepancy in participation for rural communities, because they are often naturally a minority measured in number of people living there.

This feeling of being a minority in a decision that greatly impacts your way of living might determine the amount of public support communities give to proposed energy projects. Several of the informants (I3, I5, I8) emphasized the importance of local support for nuclear energy projects to materialize, a determinant factor also mentioned by Carley et al. (2020). In their review they found that the most important factors for support and opposition of energy technologies are trust, knowledge, political orientation, and perceived benefits and ills (Carley et al., 2020, p. 13). I will argue that this finding highlights the importance of including lay

people in the decision-making process, especially because of the political nature of the discussion regarding energy advances. I8 stated for instance that one way to further include affected parties is by conducting impact assessments, and public meetings and hearings.

I1 and I5 believe that NP will experience greater support from the get-go than wind, referring to percentage of people already supporting it. I3 on the other hand, explained that wind has been trough "The Valley of Despair", and believes that NP will experience the same kind of resistance in a few years. Eikeland et al. (2023) looked at how procedural justice occurs and is experienced in the wind power debate. They found that many municipalities criticized the possibility for participation in the decision-making process, information in the planning process was lacking, but also the overall decision-making process (Eikeland et al., 2023, p. 7-8). This supports the arguments from I6 who highlighted that the process for onshore wind has a lot of weaknesses. Conflicts regarding onshore- and offshore wind or hydropower is not new to Norway, and thus there is a lot of potential to learn from these processes and create better processes for nuclear energy.

6.3 The nexus between justice, regulation, and governance

There is a connection between risk governance and energy justice in the nuclear sector, and they should be considered in the interplay with each other. What has been discussed in the two preceding chapters highlight that the theoretical frameworks are important to understand how Norway can build a transparent and legitimate process for implementing new nuclear technology. There is no political green light for NP in Norway (NOU 2023:3, p. 18; Øystese et al., 2024; Energi21), even though a majority of the Norwegian people are for building NP in Norway (Opinion, 2023). There thus seems to be a discrepancy in how policies are designed, and the public's opinion on NP. A recurring argument for those opposing NP, in this case also the Norwegian government, is that the technology is immature, and that Norway lacks competent people.

Many will argue that the nuclear technology is too immature, though the SMR technology is in use in many countries, such as Russia, China, and Japan, and under development in many other countries (i.e. Canada, the U.S., Sweden) (IAEA, 2020, p. 2-4). It was said by several of the informants that if it is true that competency is a problem, i.e. for those who are to work in the project organizations, the power plants, and those who build the plants, then Norway should rather focus on building this competency and organizations responsible for it. Instead of using

it to say that Norway cannot and should not focus on NP, they should focus on building the necessary competency. It is apparent that NP and its functions are subject to sociopolitical ambiguity. Renn (2020, p. 97) states that NP consists of high complexity and ambiguity, but little uncertainty. It is subject to little uncertainty mainly because there is a lot of knowledge on the field, which was also emphasized by some informants (I1, I2, I5, I7). By building a strong knowledge foundation the organization that is set to handle the nuclear regime will be more robust in meeting the complex situations that NPPs entail.

The foundation of knowledge will in turn influence the risk perception of the public and politicians. It is important that experts, stakeholders, and the public are involved in the risk governance processes (Renn, 2020, p. 98), and this is also the main narrative in procedural justice. By including not only the public, but especially the local community where energy infrastructure is intended, one can ensure greater local support, thus enabling fair representation and transparency. Additionally, when a community experiences due process, it is more likely that they will support the new addition to their area (Ash, 2010). This can furthermore lead to better energy policies, because it is founded on the majority's wish and opinion. There are many possibilities to learn in this aspect from the processes that have been conducted, or the lack thereof, regarding wind power. Ash (2010, p. 259) points to a study by the U.S. National Research Council (1996, p. 87) that "warns of interested and affected parties feeling disenfranchised from the regulatory process".

Energy security is defined as *"the feature (measure, situation, or a status) in which a related system functions optimally and sustainably in all its dimensions, freely from any threats*" (Azzuni & Breyer, 2018, p. 5). Diversifying the energy mix with energy sources that are not intermittent could thus enhance energy security substantially, also according to how I7 defined energy security. This definition could also incorporate the energy system, meaning the regulation regime, regulatory agencies, and organizations operating the power plants. If one argues that the energy system is part of the critical infrastructure, which has been stated by both Svegrup et al. (2019) and DSB (2016), it is pivotal that it functions at all times. Intermittent energy sources are less resilient towards weather changes, thus weakening its functions depending on the weather. This is not to say that Norway should get rid of its intermittent energy sources, but rather build upon their strengths and weaknesses, to further stabilize the energy production. Norway could strengthen its energy security and security of supply by including

NPPs in their energy mix, if they manage to organize the regulatory regime and include processes in a transparent and independent way.

It is therefore important to mention that energy security also entails all processes that are conducted when implementing new energy technologies. Those processes also include the impact assessments, public hearings, national elections, and siting processes before a technology is chosen. I will argue that energy security therefore goes hand in hand with what is mentioned in the previous sections. Education of lay people in the form of risk communication is important so that the society understands the level of risk and security present, while helping the society form opinions on the matter based on factual information. Concurrently it is as important to shape policies and regulations in accordance with the opinions of both lay people and experts, to establish a stronger acceptance.

I would argue that if Norway continues this path of excluding NP's potential and only focus on hydro and wind power, they will experience not only a decreasing public support for renewable energy projects. They could potentially lose their position as a frontier for new technology in the future. With the ongoing electrification of society and the need for energy sources that are either renewable or emits less CO2, Norway should start evaluating its existing systems and regulations to see where the shortcomings considering NP are. By starting this process now, which is a time-consuming process that entails many stakeholders and factors, they could be ready in ten years. Additionally, by starting the process of evaluating regulations and conducting public hearings now, Norway would ensure a better nuclear energy process than they have done for hydro dams and wind farms. Furthermore, it is pivotal that decision-makers and politicians keep a longer time frame in mind, because all the aforementioned factors build a more robust and secure risk governance. This can in turn enhance both the national security and energy security, especially when considering that energy security entail more than just the security of supply.

7 Conclusions and recommendations for further work

How can Norway ensure a legitimate and transparent process with regards to the implementation of nuclear power, with the goal of enhancing the energy security?

To answer the problem statement, I will return to the two research questions for this thesis. The first question concerns *the regulations and procedures that are needed for Norway to implement nuclear power*. Findings from interviews show that there are several regulatory frameworks present, both with national and international standards, that will ensure the safe and secure operation of NPPs. The Norwegian regulations are, on the other hand, outdated and need to be updated and revised in order for them to handle a nuclear technology that is set up to produce power. Even though the regulatory framework is adequate for the present system with nuclear research reactors, IAEA (2019, p. 78) mentioned in their IRRS report that the framework should be more comprehensive, reviewed and developed as necessary. This is in line with the statements given by some of the informants. Additionally, the DSA is currently not given a mandate to regulate nuclear energy that produces power, thus limiting their ability to regulate a whole industry. DSA also lacks adequate personnel, both in number of personnel and their competencies (I8; DSA, 2019, p. 51). The independence of DSA from external and political pressure is important, but they do receive funding from several Ministries that can affect their independence. DSA (2019, p. 51) also stated that the funding is adequate which affects both their personnel competency and number of people being able to work on their regulatory tasks.

It is found that an appropriate regulatory regime might be meta-regulation, where the NPPs and its organizations are expected to self-regulate and evaluate, to enhance the independence and minimize the risk of creating a regulatory regime that led to the catastrophic accident in Fukushima (Wang & Chen, 2012). This could also encourage a more dynamic learning process between the organizations that operate the power plants and the external regulatory agency. This thought process is founded on the fact that the nuclear sector is subject to rapid changes and regulatory changes are part of bureaucratic processes that take a long time. This creates the possibilities for the operating organizations to create better and more secure internal regulatory frameworks, while external regulators function as “the checks” to the checks and balances. Thirdly, on the question on competency for the nuclear sector, many informants argued that there are synergies that can be drawn from the petroleum sector. People in the petroleum sector will also be in need of a job when Norway starts decommissioning oil and gas. These are people that in many ways can work in the nuclear sector, though with some retraining.

The second research question looked at *how Norway can improve its procedures when diversifying its energy mix.* The study found that much of the literature has focused on procedures regarding wind-, hydro-, and solar-power because those are the energy sources generally regarded as sustainable and green, but also because most countries have looked to those energy sources when seeking to diversify their energy mix. Many of the wind- and hydro-projects are generally conflict-ridden, especially when looking at Norway. This points to a need for a review on the public processes involving local communities and stakeholders, and that the Government not only includes the stakeholders that have special interests in the projects. Much of the empirical literature and informants argued that there is a lack of inclusion and focus on the impact that the energy projects will have on communities, thus creating a divide and mistrust between the State, organizations, and lay people. Further, it was found that NP is an energy source that penetrates well into the economy, thus creating more jobs than wind or hydro power. This creates a ripple effect that can enhance local communities in the districts of Norway, and furthermore enhance national security.

Lastly, establishing a regulatory regime that encourages self-regulation and mutual learning between organizations operating power plants and the regulatory agency, could strengthen the state of safety and security in the sector. This is done by enabling the organizations to create internal regulatory regimes that fit their operations, enabling them to better identify risks associated with their operations, while the regulatory agency is encouraged to learn from them, and vice versa. Additionally, this could help in creating more inclusion with lay people and local communities, because it is in NPPs organizations and regulatory agencies' interest to have local acceptance and understand the risk perceptions of the society. All of the aforementioned aspects help ensure Norwegian energy security, because the processes are incorporated in the dimensions that create energy security as a whole.

7.1 The study´s contribution

This study has contributed to research on Norwegian procedures and regulations in regard to nuclear power, with a focus on justice and risk governance. It has pointed out several gaps within the research regarding justice and governance in a nuclear perspective from a Norwegian viewpoint, seeing that there is little research on that specific field. The study can be used as a foundation for further research on necessary processes that include lay people and local communities more, should Norway decide to diversify its energy mix with nuclear power. It has shown that it is pivotal for energy projects' survival to gain local acceptance, and it has

exemplified what can go wrong if this does not happen. In relation to previous research and publications on the Norwegian energy system, this study has shown that there is a discrepancy between the Government and its wishes (NOU 2023:3; Koestler et al., 2020), e.g. that the Government sees the need for stabile energy sources, while they push for more wind power production.

7.2 Further research

It is indicated within the study that the subject of nuclear power might be challenging, because of the status of the public debate in Norway. This was especially prevalent in the interview process, where many people rejected the invitation to be interviewed, and many never responded at all. It would thus be interesting to further research the possibilities for nuclear power in certain municipalities with a quantitative study to reach a larger audience, and how the processes for inclusion and acceptance occur at a municipal level in comparison to other energy projects, such as off- and onshore wind. It would also be valuable to further research national processes and how political parties in Norway determine their policies, to investigate whether justice is an important aspect throughout the decision-making processes. Lastly, I see the need for more stakeholder and local communities' involvement in future research projects, to strengthen the governance processes.

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Appendix

Appendix A: Interview guide

Brief introduction about the purpose of the interview and my role.

The purpose of this interview is to gather data for my Master´s Thesis in Societal Security, the department of Technology and Safety at UiT, the Arctic University. The interview will focus on how to ensure energy security in Norway, while diversifying the energy mix. The focus will be on nuclear power, and if or how, it is possible to include the nuclear power in the energy mix in Norway.

The interview will be audio-recorded and transcribed.

Section 1: Background and context.

1. What is your name, age, and occupation?
2. What is your experience working with energy supply security?
3. Do you have any experience working with or researching nuclear power?

Section 2: Energy Supply Security

4. Can you in your own words define energy supply security?
5. How do you perceive the Norwegian energy supply security today? (Give definition on energy supply security beforehand!).
6. Should the Norwegian Government have energy-self-sufficiency as a goal, or would that be unrealistic?
7. How can Norway ensure its energy supply security in light of unstable energy supply from Europe?
8. How do you think Norway is doing in regard to renewable energy compared to other countries (such as Sweden, Finland and Denmark)?

Section 3: Nuclear Energy

9. Opponents of nuclear power often mention nuclear waste as a problem, especially how to store and handle it. How could Norway handle the problem of nuclear waste? (e.g. options for short-term and long-term storage).
10. If Norway where to implement nuclear power plants, what factors should be considered for site selection?
11. Local authorities have gotten more decision-making power when it comes to areal planning and energy sources. How do you think the system should be set up in regard to nuclear power plants?
12. Do you believe the regulatory framework for the implementation of nuclear power plants are robust and well-defined?

Section 4: Challenges and Barriers

’s energy mix

Appendix B: Application to SIKT

Sikt

Vurdering av behandling av personopplysninger

Referansenummer
968255

Vurderingstype
Automatisk

Dato
26.01.2024

Tittel
Diversifying the Norwegian Energy Mix: Towards Nuclear Power Plants

Behandlingsansvarlig institusjon
UiT Norges Arktiske Universitet / Fakultet for naturvitenskap og teknologi / Institutt for ingeniørvitenskap og sikkerhet

Prosjektansvarlig
Masoud Naseri

Student
Oda Rønning Vikan

Prosjektperiode
01.01.2024 - 31.07.2024

Kategorier personopplysninger
Alminnelige

Lovlig grunnlag
Samtykke (Personvernforordningen art. 6 nr. 1 bokstav a)

Behandlingen av personopplysningene er lovlig så fremt den gjennomføres som oppgitt i meldeskjemaet. Det lovlige grunnlaget gjelder til 31.07.2024.

Meldeskjema

Grunnlag for automatisk vurdering
Meldeskjemaet har fått en automatisk vurdering. Det vil si at vurderingen er foretatt maskinelt, basert på informasjonen som er fylt inn i meldeskjemaet. Kun behandling av personopplysninger med lav personvernulempe og risiko får automatisk vurdering. Sentrale kriterier er:

- De registrerte er over 15 år
- Behandlingen omfatter ikke særlige kategorier personopplysninger;
  - Rasemessig eller etnisk opprinnelse
  - Politisk, religiøs eller filosofisk overbevisning
  - Fagforeningsmedlemskap
  - Genetiske data
  - Biometriske data for å entydig identifisere et individ
  - Helseopplysninger
  - Seksuelle forhold eller seksuell orientering
- Behandlingen omfatter ikke opplysninger om straffedommer og lovovertredelser
- Personopplysningene skal ikke behandles utenfor EU/EØS-området, og ingen som befinner seg utenfor EU/EØS skal ha tilgang til personopplysningene
- De registrerte mottar informasjon på forhånd om behandlingen av personopplysningene.

Informasjon til de registrerte (utvalgene) om behandlingen må inneholde

- Den behandlingsansvarliges identitet og kontaktopplysninger
- Kontaktopplysninger til personvernombudet (hvis relevant)
- Formålet med behandlingen av personopplysningene
- Det vitenskapelige formålet (formålet med studien)
- Det lovlige grunnlaget for behandlingen av personopplysningene
- Hvilke personopplysninger som vil bli behandlet, og hvordan de samles inn, eller hvor de hentes fra
- Hvem som vil få tilgang til personopplysningene (kategorier mottakere)
- Hvor lenge personopplysningene vil bli behandlet
- Retten til å trekke samtykket tilbake og øvrige rettigheter

Appendix C: Project background and consent form

Vil du delta i forskningsprosjektet

«Diversifying the Norwegian Energy Mix: Towards Nuclear Energy"

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å finne ut hvordan Norge kan forsikre en transparent og legitim prosess ved opprettelsen av nye energikilder. Hovedfokus vil være på energiforsyningssikkerhet med hensyn til opprettelsen av kjernekraftverk. I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål

Datainnhentingen er en del av en masteroppgave skrevet i studiet Samfunnssikkerhet. Omfanget på oppgaven er på mellom 15,000 og 25,000 ord, noe som tilsvarer mellom 50 og 70 sider. Oppgaven skal skrives på engelsk, men på grunn av språkbarrierer vil intervjuet foretas på norsk og transkriberes til engelsk.

Oppgavens problemstilling er som følger: «How can Norway ensure their energy security with regards to new energy sources, while maintaining a legitimate and transparent process?». I tillegg har oppgaven to forskningspørsmål, som søker å gå mer i dybden på kjernekraft og diversifisering av energimiksen.

- Forskningsspørsmål 1: «What are the key regulatory hurdles and considerations unique to Norway's energy system when it comes to implementation of nuclear power?".
- Forskningsspørsmål 2: "How can Norway further diversify its renewable and low emission energy sources to ensure a secure and sustainable energy system?".

Hvem er ansvarlig for forskningsprosjektet?

UiT- Norges Arktiske Universitet i Tromsø er ansvarlig for prosjektet.

Hvorfor får du spørsmål om å delta?

Utvalget er basert på en antakelse om at forespurte personer har kunnskap om energi, forsyningssikkerhet og alternative energikilder. Antakelsene er basert på utsagn i offentlig diskusjon, samt informasjon hentet fra internett. Oppgaven tar sikte på å intervjue 6-9 personer med variert kunnskap, og som har ulike synspunkt på blant annet energimiksen i Norge. Kriteriene som har blitt

brukt for utvalget baserer seg på at det er offentlige personer, gjerne forskere eller andre fagpersoner. Utvalgsmetoden er basert på snøballmetoden, og kontaktopplysninger er hentet fra internett.

Hva innebærer det for deg å delta?

Hvis du velger å delta i prosjektet, innebærer det et intervju på ca. 45 minutter som vil bli tatt opp med lyd. Intervjuet vil være semi-strukturert, slik at det gir rom for at du kan prate delvis fritt og skape en bedre samtaleflyt. For å systematisere informasjonen og skille mellom ulike fagpersoner vil alder, kjønn, stilling og bosted registreres. Dette for å se om disse faktorene fører til meningsvariasjon.

Informasjonen som kommer fram, vil registreres og transkriberes slik at det kan brukes i oppgaven. Alt vil også bli anonymisert.

Spørsmålene vil blant annet handle om energimiksen i Norge, energisikkerhet, kjernekraft og utfordringer.

Det er frivillig å delta

Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykket tilbake uten å oppgi noen grunn. Alle dine personopplysninger vil da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger

Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket. Det er kun veileder, Masoud Naseri, og meg selv, Oda Rønning Vikan, som vil ha tilgang til de ikke-anonymiserte dataene som kommer fram i intervjuene. Personopplysninger vil lagres separat fra øvrige data. De vil kodes før de settes inn i oppgaven, og lagres på en ekstern harddisk.

Hva skjer med personopplysningene dine når forskningsprosjektet avsluttes?
Prosjektet vil etter planen avsluttes 3. juni 2024, datoen oppgaven skal leveres. Etter prosjektslutt vil alt datamateriale samt personopplysninger anonymiseres. Dersom det er ønskelig, kan det slettes.

Hva gir oss rett til å behandle personopplysninger om deg?
Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra UiT- Norges Arktiske Universitet i Tromsø har Sikt – Kunnskapssektorens tjenesteleverandør vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Dine rettigheter
Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke opplysninger vi behandler om deg, og å få utlevert en kopi av opplysningene
- å få rettet opplysninger om deg som er feil eller misvisende
- å få slettet personopplysninger om deg
- å sende klage til Datatilsynet om behandlingen av dine personopplysninger

Hvis du har spørsmål til studien, eller ønsker å vite mer om eller benytte deg av dine rettigheter, ta kontakt med:

- UiT- Norges Arktiske Universitet i Tromsø ved Førsteamanuensis Masoud Naseri, på mail masoud.naseri@uit.no eller telefon 77660327/46378001.
- Vårt personvernombud: Annikken Steinbakk, på mail personvernombud@uit.no eller telefon 77646952.

Hvis du har spørsmål knyttet til vurderingen som er gjort av personverntjenestene fra Sikt, kan du ta kontakt via:

- Epost: personverntjenester@sikt.no eller telefon: 73 98 40 40.

Med vennlig hilsen

Prosjektansvarlig *Eventuelt student*

(Forsker/veileder)

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet ***«Diversifying the Norwegian Energy Mix: Towards Nuclear Energy"*** og har fått anledning til å stille spørsmål. Jeg samtykker til:

- ☐ å delta i intervju

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet

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(Signert av prosjektdeltaker, dato)