Report

Energy modelling and social factors

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Abstract

Energy system models are often used to map out the transition to zero carbon energy systems, but they usually lack a representation of social factors that may shape and affect the actual energy transition. In this study ways of incorporating social factors in energy system models are suggested, making the model solutions efficient as well as socially inclusive. This will be done by looking at the implementation of wind power in Norway, which has proven to be controversial. By considering the development of wind power plants and the social acceptance of such, I will identify some common assumptions about wind power opposition. These assumptions are underlying in the energy system models and will therefore bias the solutions presented by the models. As a consequence, I will suggest energy system models should be made more sensitive to local communities by either mapping out social interest in a more extensive way or by allowing for a segmented discount rate.

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1. Introduction

1.1. Objective

Energy system models are used as a way to map out how to transition to zero carbon energy systems. These models include a high level of technoeconomic detail and can help the policy makers and planners in deciding what technologies should be used in order to achieve lower emissions. The models do however tend to lack a representation of social factors that will actually shape the energy transition. Factoring in aspects of energy justice, social acceptance and social inclusion in energy system models may drastically change the solutions suggested by the existing models to solutions that are efficient as well as socially inclusive. The models are based on some underlying assumptions about human behavior. These assumptions might be unrealistic at times, and the models thus be biased towards certain technologies. A further objective is thus to identify some of assumptions and how they can limit the energy system models with respect to incorporating a social dimension.

The report will use the example of wind power in Norway in order to discuss how the social dimension arguably and unintentionally has been neglected. There are social costs and benefits associated with the development of wind power. By using the framework of energy justice as a conceptual tool in order to assess the distributive and procedural aspects of wind power, we will understand that some of the social costs are dependent on the siting of the turbines. Some of these social costs can for example be destruction of landscape or nature, increased noise or decreased housing prices in areas located close to the turbines. It will be showed that the implementation of wind power has led to an unfair distribution of ills and benefits, and it thereby has increased the opposition and costs of projects to the developers. The objective is to identify these problems and how they can be resolved by the decision-makers.

1.2. Limitations

A limitation of this report is that it doesn't assess whether or not the net effect of wind power is beneficial to society. This would demand a more extensive analysis of the externalities associated with the development of wind power, and the result of such

an analysis would probably depend a lot upon the siting of the turbines. The scope of the research is rather to assess the energy system models used and to what extent they have been accounting for social factors. A further limitation is that there is a lack of focus on the social dimensions of wind power in a global perspective. There are several externalities associated with the upstream and downstream processes of constructing a wind turbine, and recent research from Sovacool et al. (2020) connects decarbonization with ecological destruction, gender inequality, child labor, and dispossession. I refer to Sovacool et al. (2020) for further research on this topic. A further weakness in both this report and some of the literature surrounding energy justice has been that it mainly is concerned with ethics and morality among and between humans (Sovacool et al., 2017). This report will mainly discuss the topic of social acceptance and human empathy is, to some degree, limited to humans, so this is what is most important to explore the phenomenon of social acceptance. In order to have achieve a nuanced discussion about energy justice, we should also consider justice for the wildlife and nature. Energy justice seeks to embed principles of justice, social equity and fairness into energy systems and energy system transitions (Sari, et al.) I refer to Sovacool et al (2017) for further discussion.

1.3. Report's structure

The first part of this report will focus on the theoretical framework. Energy justice is a handy and well-used tool applied to assess the social impact of any implementation of new technology. I will introduce the three tenets of energy justice, which throughout the report will be used as a tool in order to evaluate to what degree justice, social inclusion and social acceptance have been considered in the energy transition. I will then go on to explain the energy system models and some of the underlying assumptions and some problems that can be easily identified. Now, this should be read as a brief explanation to the concept of energy system models. This will immediately point out some of the limitations of energy system models with respect to incorporating a social dimension.

I will then go on to discuss the implementation of wind power in Norway. The reasons why I use this example is that there is already a lot of research on the topic as there has been heated debates regarding the distribution of benefits and ills of wind power

in Europe and furthermore that there arguably is more room for improving the incorporation of a social dimension in the energy system models. I will start by theorizing social acceptance based on the research from other European researchers, before I go on to discuss some of the more common underlying assumptions about wind power opposition as per Aitken (2010). These assumptions may to some extent serve as a guideline and reminder for what to avoid in the following discussion about wind power opposition. Furthermore, the assumptions will be key in the following discussion, because it might be reasonable to believe that these assumptions also are some of the reasons to why there has been an increase in resistance against wind power.

The next section will then briefly discuss the externalities associated with the implementation of wind power. An externality occurs when the production or consumption of a good cause a cost/benefit on third parties that are not directly related to the transaction. This will however not be an extensive analysis of the externalities associated with wind power, and for a more thorough analysis I refer to Zerrahn (2017), Meyerhoff et al. (2010), Mattmann et al. (2016), Schleisner (2000).

After having theorized both the social acceptance and the externalities of wind turbines, we go on to discuss the particular case of Norway. There are several reasons to why the case of wind power in Norway differs from that of their European counterparts. The licensing process will be explained and discussed as per Inderberg et al. (2019). It will be emphasized throughout what formal position both the local communities and the municipalities have in the licensing process. I will then go on to discuss both the licensing process and the distribution of ills and benefits in term of energy justice.

There will then be a discussion about how we can understand and enhance social acceptance based on fair distribution of ills and benefits and due processes. In this section I will also go on to discuss some of the specific attempts and changes in policy making that the government has suggested in order to mitigate the resistance. I will explain what the policy changes have been trying to address, and what aspects of the three tenets of energy justice they might have improved or worsened. This is key in order to understand the controversies surrounding wind turbines in Norway.

Ultimately, I will go on to discuss what lessons are to be made by energy system modelling. I will try to discuss how some of the mistakes done in the case of wind power in Norway might relate to the more common assumptions about wind power listed by Aitken (2010). Furthermore, I will make some suggestions about how these assumptions may be avoided in future energy system models.

2. Defining energy justice

There are many features of energy production and use that will have a significant impact on fairness and justice (Jones et al., 2015). The cost of climate change is assumed to fall disproportionally on the least developed countries and on the poorest of the poor in these nations (Smith et al., 2013). Hence, transitioning into a greener society may well be ethically correct from a fairness and justice point of view, because it will minimize the harm done to the environment in the long run, and thereby make future generations less vulnerable to the threat of increased costs imposed by global climate change. A transition into a greener society is thus assumed to be fair from an intergenerational point of view, there is however, no guarantee that the benefits and burdens of this transition will befall equally on everyone. It is rather likely that the costs of the transition will befall on the least developed countries and the world's poorest. So although it becomes clear that a transition into a low carbon energy system might be beneficial to future generations and the global south, the development of these technologies may also affect distributional effects on a national, regional or local level. The implementation of wind power in Norway provides us with an example where the costs of wind power evidently befalls those who are located in close proximity to the turbines, whereas the benefits these people receive appear to be limited. On the other hand, Norway is benefitting from exporting oil and thus contributing to climate change most strongly felt in other parts of the world. So, under the assumption that wind power is more sustainable, Norway's part in improving the world in terms of energy justice could be to generate more wind power and possibly export it to more oil or coal dependent countries in Europe. It is therefore important to recognize the different levels at which energy justice is a relevant term. We can discuss it in a regional, national or

international context. Throughout this report, we will mainly focus on the national level, but the discussion about the national level is also relevant for the international level. If the energy system in a country is perceived as very unfair it is not unlikely that it may affect the energy system in the long run through political voting. This is why it is so important that a transition to a green energy system has to be inclusive.

Sovacool et al. (2017) argues that we clearly need new ways of approaching the world's energy dilemmas. The concept of energy justice is one possible answer to this and aims to fairly disseminate the benefits and costs of energy services by looking at the energy system in a global perspective (Sovacool et al., 2017). Furthermore, the application of energy justice is associated with a representative and impartial decision-making (Sovacool and Dworkin, 2014, Sovacool, 2013). Energy justice aims to provide individuals in a global perspective with affordable, safe and sustainable energy by applying principles and concepts from social justice (McCauley et al., 2013).

The most common way to present the theoretical framework of energy justice is by introducing three different cores that have emerged in the existing literature: distributional, procedural and recognition justice (McCauley et al., 2013; Heffron and McCauley, 2014; Sovacool et al., 2016). The three different tenets will in many cases be overlapping and interlinked. This opens up for an understanding on how to tackle injustice: (a) identify the concern (distribution), (b) identify who it affects (recognition) and then (c) identify strategies for remediation (procedure) (Jenkins et al., 2016).

2.1. Distributional Justice

Distributional justice concerns the unequal distribution of both ills and benefits (Jenkins et al., 2016). In the context of energy systems, this can both be the unequal siting of infrastructure or the access to energy services. An example of this is the location of wind resources, which inevitably will affect some people more than other due to its physical location (Saglie et al., 2020). Some researchers have demonstrated that it is often the poorer social groups that are disproportionately affected by wind power in the UK (Todd and Zografos, 2005). There seems to be a

clear conflict of interest about the implementation of wind power between the local and global communities. The siting of the wind turbines will affect the local community negatively but is often assumed to have a positive impact on the global emissions (Keith et al., 2004; Enevoldsen et al., 2019). In order to achieve distributional justice, it is thus necessary to compensate the local communities for their “sacrifice” and increased costs. Again, this is subject to personal evaluations and perspectives, and this is exactly why it is so hard to achieve a fair distribution of the burdens and benefits (Jenkins et al., 2016; Saglie et al., 2020).

2.2. Recognition Justice

Recognition justice states that all individuals must be fairly represented, free from physical threats and offered complete and equal political rights (Schlosberg, 2003). In order to achieve recognition justice, we have to accept and include different cultural values, arguments and the benefits and burdens related to energy systems (McCauley et al., 2013). In order to achieve this, the decision-maker or developer need sufficient information about who are affected, their cultural traditions and way of living. There tend to be several interests to consider when discussing energy systems, however if the decision-maker or developer have done their research about local interests sufficiently in the planning process, it is more likely that they will plan projects that will benefit the groups affected (McCauley, 2018).

2.3. Procedural justice

Procedural justice concerns then decision-making process that decides the above-mentioned distribution. It states that all groups affected should be able to participate in the decision-making and that their concerns and values should be taken seriously throughout the process (McCauley et al., 2013; Jenkins et al. 2016). In order for a process to be perceived as fair, all parties affected must be included in a manner such that they feel that their opinion is valued and heard (McCauley, 2018). When the different groups with the different interests have been heard and feel that their opinions and values have been considered by the decision-maker, it is easier to accept the final decision even though it might rule against your own interests (Saglie et al., 2020). Hence, it is also of importance that the process itself is transparent and open, so that all individuals are able to speak up their opinions and to see clearly

what motives have been emphasized by the decision-maker. Especially in cases where there are two opposing groups, it is important to make the weighting process clear, so that any final decision is easier to understand and thus likely easier to accept. While recognition justice is trying to capture the importance of including all the interest of society, procedural justice is trying to capture the importance of including all of these interests into the decision-making process.

As identified by Sovacool and Dworkin (2015), energy justice can be used as a conceptual tool for integrating several different concerns. It can be used an *analytical tool* in order to understand how and when injustice arise. But it can also be used as a *decision-making tool* and thereby helping the decision-makers to implement fair and just policies which again will lead to social acceptance. Throughout this report, energy justice will be used as an analytical tool, assessing to what extent energy justice has been incorporated in the case of wind power development in Norway. And then we will go on to suggest certain ways of incorporating a social dimension into the planning of future energy system, thereby using energy justice a *decision-making* tool. The different cores of energy justice will be used throughout, but it is however often the case that the terms will overlap and adjustments in the developing process might address one of the cores, but simultaneously affect another.
First, I will however expand the theoretical foundations of this report by explaining energy system models and some of the underlying assumptions behind.

3. Energy system modelling

3.1. Energy system modelling: purposes and challenges

The main purpose of energy system optimization modelling is to represent possible evolutions of the future energy system in a local, national or global context over several decades, without necessarily identifying how likely the different possible evolutions are (Pfenninger et al., 2014). Hence, constructing a model inevitably mean that we have to identify certain parts of the reality. In order to make a good and unbiased analysis of the sustainable energy development, the modelers have to anticipate possible future outcomes under a variety of different scenarios that have to consider future energy demand, technology innovation, resource availability, future prices, and new energy and environmental policy (DeCarolis et al., 2017). Energy

infrastructures are long-lived, so the model scenarios that aim to show the changes in capital stock in response to new policy must manage to analyze for the next few decades (DeCarolis et al., 2017). However, given the uncertainty with the prediction of a future world, some of these analyses will at times give very misleading conclusions. This in turn makes it difficult to validate the model results that cover multiple decades through actual outcomes, even if the input data is of very high quality. Energy system optimization models are often used to evaluate the system-wide impacts of energy development within a consistent framework. The goal of the model is to find future estimates of technology capacity and utilization, marginal commodity prices, and emissions across the energy system (DeCarolis et al., 2017). A perfect model would incorporate all parts of reality, and perfectly predict the future prices, technologies, policies, and all other aspects that possibly could affect the energy market. The energy system optimization models are thus assuming to have perfect foresight into the future and are optimizing the energy system from a decision-makers perspective. They are often thought of as a modelling approach where the goal is to minimize or maximize a function subject to a number of constraints, and thereby computing a number of decision-variables (Lund et al., 2017). These decision-variables will then characterize the solution of the optimal energy system design. However, given the uncertainty we are facing while planning a future energy system, it might also mean that specific models might be biased towards certain technologies, infrastructure or solutions due to unrealistic assumptions or scenarios (Gilbert and Sovacool, 2016, Sovacool et al., 2014).

DeCarolis et al. (2019, p. 185) lists the following strengths of the energy system optimization models: “First, they provide a consistent accounting framework for specifying the techno-economic performance characteristics of all modeled processes. Second, the model formulation allows for quick and efficient normative goal seeking within highly complex systems. Third, the results can suggest a wide range of energy futures that reflect energy and environmental policy objectives. Fourth, energy system optimization models can capture sectoral interactions that can lead to cross-cutting insights, which are hard to capture in sector-specific models.” Hence although there are a lot of uncertainties and possible problems related to the usage of energy system optimization modelling to plan the future energy systems, it can also be used as a critical tool by government agencies around the world to

develop energy planning strategies. Energy system optimization modelling can for example play a crucial role in developing a long-term strategy to mitigate the emissions of green-house gases.

3.2. Uncertainty and scenarios

Because the purpose of energy system modelling is to plan for the future energy systems in the next decades, an important part of the modelling is to identify different scenarios based on different predictions or beliefs about the future. Predicting socioeconomic development is more difficult than predicting the evolution of a physical system. This is because it entails predicting human behavior, policy choices, technological advances, international competition and cooperation (Collins and Knutti et al., 2013, 1036-1037). The common approach is to use different scenarios of plausible socioeconomic development. It is less common to assess a likelihood of occurrence on the different scenarios (Collins and Knutti et al., 2013). Rather, the scenarios are used in order to identify a lot of different possible outcomes. The outcomes from all the different scenarios provide the policymakers with alternatives and several different possible futures to consider. One example of how there is an uncertainty associated with the predictions of future energy systems is illustrated below. Hoekstra (2017) show the predictions for the solar industry made by the International Energy Agency (IEA) from 2002 to 2017 consistently are underestimating the potential of growth. Solar photovoltaics convert the sun’s energy into direct current energy. There is a disconnect between the historic projections of

photovoltaics (PV) and the actual development.

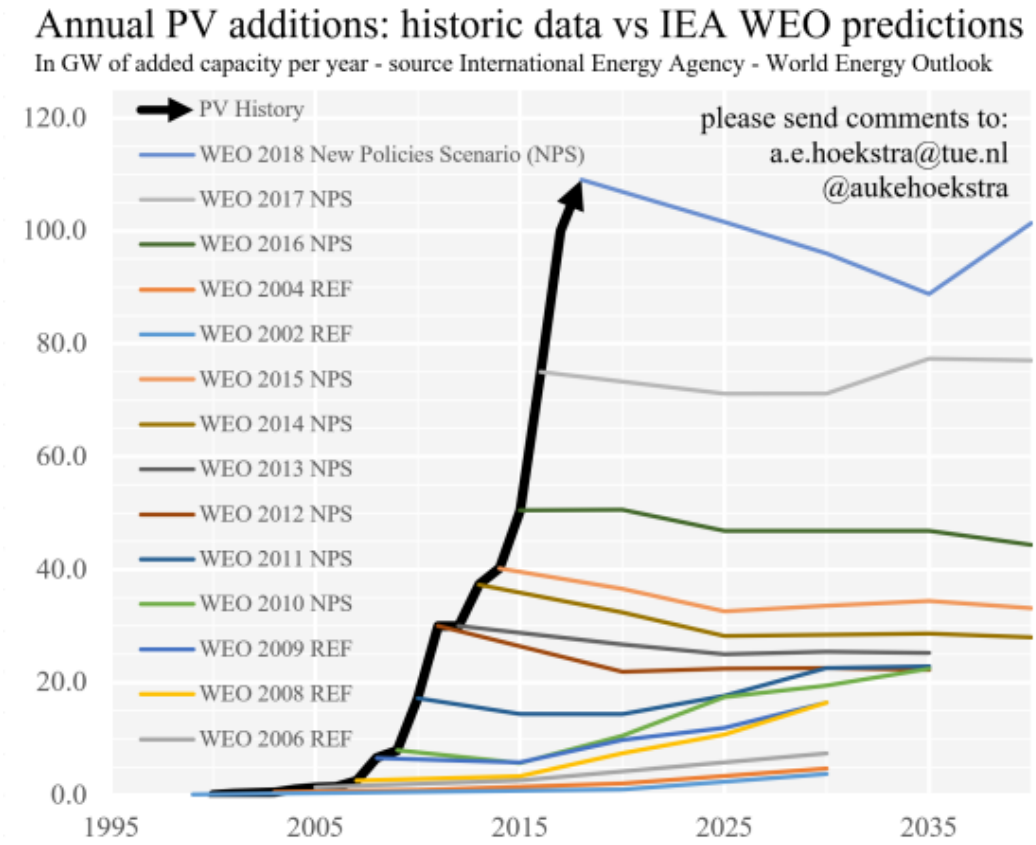

Figure 1. Historical projections of solar power capacity made by the IEA compared to the actual development of solar power. Copied from Auke Hoekstra (2017) URL: https://maartensteinbuch.com/2017/06/12/photovoltaic-growth-reality-versus-projections-of-the-international-energy-agency/

Hence, it is safe to say that there are a lot of uncertainties associated with the predictions that are so important to the outcomes predicted by the energy system modelling. The graph above show us that even the year to year projections can consistently be wrong and underestimating the development of one technology. The result of this could be that the solutions is biased towards certain technologies. Similarly, we have to understand that there are a lot of uncertainties associated with the expectations about the future, in terms of technology development, change in policies, and etc. An underestimation of the cost of development of a certain technology might thus lead to an outcome with less use of this technology than what might benefit society. Similarly, new policies that favors certain technologies might also affect the final outcome predicted in the energy system modelling. One way of addressing this problem is by creating a variety of scenarios that can range from

‘worst case’ to ‘best case’ scenario. Then the optimal solution will depend upon which scenario we choose.

3.3. Homo economicus

The theoretical foundations for the solutions delivered by the energy system optimization modelling is based on neoclassical economic theory (Schleich et al., 2016). This implies that the optimal solution is the one with the highest surplus, which typically is achieved through market mechanisms and minor regulations in case of market failures.

Furthermore, the theoretical foundation of neoclassical economic theory is subject to a number of assumptions regarding human behavior and how the agents act in the market. This includes that all agents (consumers and producers) are utility-maximizing and acting in their own self-interests, that they have full information and that they are acting rationally. Hence, energy system modelling is capturing how the energy system would look if all consumers and producers act rational and according to these assumptions. In real life, there is however examples of deviations from these assumptions in human behavior (Mullainathan and Thaler, 2001; Hursh, 1984). The agents never have full information about the present and future, they might be risk averse, they might not have the sufficient time to gather information in order to make an informed decision, or they might value other stuff with a product than what is reflected in the market pricing (like for example the environmental aspect or ecological biodiversity). Thus, deviations in human behavior from these assumptions might actually give rise to unexpected outcomes in the energy system. This naturally raises a conflict between the energy system and the people whose preferences have not been maintained in the modelling.

3.4. Discount rates

Discounting is the process of determining the present value of a future cash flow that is to be received in the future. Most people would rather receive 100$ today than receiving 100$ tomorrow, and the reason for this is that we discount future cash flows. Similarly, an investor will compare the costs of an investment today with the

present value of the expected future gains. If the costs are higher than the expected future gains, he/she will decide not to invest.

Conceptually, it is normal to distinguish two types of discount rates in energy system models. First, social discount rates, which essentially compare the costs and benefits that accrue at different points in time. The social discount rate typically reflects the pure time preferences and the decreasing marginal utility of government consumption or the opportunity costs of the government (e.g. long-term rate of return on government bonds) (Schleich et al., 2016). In the models, the social discount rate is normally used in cost-benefit analyses in order to find the optimal energy system (Harrison, 2010). The social discount rate used in the energy system in Norway is for example decided externally by the Ministry of Petroleum and Energy (OED) (NVE, 2018). The second type is the implicit discount rate (IDR) also called the subjective discount rate. The implicit discount rate is used in the models in an attempt to represent the different agents' *actual* behavior. The concept of social discount rate is thus, in contrast to the implicit discount rate, an attempt to reflect the social view on how the future should be valued against the present (García-Gusano et al., 2016). The implicit discount rate, however, is capturing the *actual* human behavior and how they discount the present vs the future. The present value is the current value of a future sum of money or cash flow. Future cash flows are discounted at the discount rate, and the higher the discount rate, the lower is the present value of the future cash flows. Typically, we will look at two different types of agents in the model; producers and consumers. Producers will consider the cost of investing today with the future cash flows associated with that investment. A producer/investor would for example compare the cost of investing in solar power with the expected future profits yielded. However, this future sum or flow of money is discounted. Similarly, the consumers could compare the expected future gains of an investment with the cost of that investment. If we consider the example of wind power, the cost imposed on the consumers could be the visibility of the wind turbines, whereas the benefit could be new jobs in their community, more money to the municipality and similar mechanisms of compensation. In real life, the actual discount rate is varying between the agents or technologies due to differences in, for example, risk aversion, uncertainty or initial capital assets.

Schleich et al. (2016) argues that the two different types of discount rates clearly serve very different purposes, but that the distinction seldom is made in an actual model-based assessment. There have for example been made arguments by Hermelink and Jager (2015) that the use of the wrong type of discount-rate is an important reason for why the European Commission did not prioritize climate policy more in 2014. They argued that the European Commission used the implicit discount rate rather than the social discount rate, which tend to be smaller.
There is no universal consensus on the use of discount rate, and theorists have disagreed about this since climate change entered the discussions in the 80s (Nordhaus, 1997; Stern, 2006). E.g. there have been arguments that, if expected future consumption is low compared to today, then having a positive, relatively large social discount rate could lead to unacceptable big intergenerational inequality (Stern, 2006). On the other hand, Hausman (1979, Individual Discount Rates and the Purchase and Utilization of Energy-Using Durables) points out that choosing a too low social discount rates also potentially could lead to a misrepresentation of the consumers behavior. And since there is no certainty about the future consumption (or access to natural resources), there is no international consensus about how to discount. Consequently, in energy system modelling one very important assumption is the social discount rate.

The role of the implicit discount rate is also paramount to understand the final results in the energy system optimization models. The result will fundamentally depend on the rate at which the individuals are discounting the future energy savings or future income relative to the required investments that have to be made today (Newell and Siikamäki, 2015). Schleicher et al. (2016) argues that the implicit discount rate consists of three underlying factors: (i) preferences such as time preferences, risk preferences, reference-dependent preferences, and pro-environmental preferences, (ii) predictable (ir)rational behavior such as bounded rationality, rational inattention, and behavioral biases such as present bias, status quo bias or probability distortion and (iii) external barrier such as lack of information or limited access to capital. Similarly, there have been studies showing that there is a heterogeneity in the implicit discount rate (Newell and Siikamäki, 2015; Enzer et al. 2014). A high implicit discount rate makes it harder to develop new technologies, because such

development requires a high initial investment. The higher the discount rate, the less weight we put on the future gains of that investment.

Finding the individual discount rates requires a lot of information, and it is thus hard to be completely accurate in the calculations. Recognizing that we are not able to incorporate the implicit discount rate perfectly into the energy system optimization modelling is key, because the use of discount rates in some cases can completely change the end-result of our analysis (Hermelink and Jager, 2015).

4. Wind power and social acceptance

4.1. Key concepts of social acceptance

Similarly to other European countries, there have been surveys in Norway finding that there is a large percentage of the population supporting wind energy (Cicero, 2018) Yet there have been instances of protests, and even accomplished attempts at stalling the construction of wind farms in Norway (Kringstad and Sandmo 2020). By drawing on literature from other European countries with more experience on development of wind power, we might be able to identify some key concepts affecting social acceptance. This might give us an impression of where the resistance in Norway originates and why it is that the implementation of wind power is so controversial even though there apparently is a majority of the public supporting it.

4.1.1. NIMBY-ism

An often-used explanation to why people opposes wind parks is the process known as “Not In My Backyard,” or NIMBY (Wolsink, 2000; Hunter and Leyden, 1995; McAvoy, 1998). The conventional view of this phenomenon is that people in general are pro wind power but are opposed to the negative externalities associated with wind turbines in their own community. We can to some extent draw parallels between this and *the tragedy of the commons*, a game often used by economists in game theory to explain why some public goods are not produced in society, even though all the individuals in that society want the good to be produced. The reason why this is happening, is that all individuals are acting according to their self-interest (maximizing utility), so all individuals want the public good, but no one wants to contribute

because this is associated with some increased private costs (Wolsink, 2006). In our case, the public good provided is energy from wind power. The costs are the negative externalities associated with the siting of the wind turbines. Thus, according to the NIMBY-argument, opposition is a result of local residents maximizing their own, personal utility. This could also explain why apparently the majority of Norwegians are supporting the development of wind power, but why the implementation is so controversial. People want the benefit of energy produced by wind power, but they do not want it 'in their own backyard.'

Some researchers have pointed out that NIMBY-ism alone is an insufficient and incomplete explanation of social acceptance (Wolsink, 2000; Wolsink, 2007). Other studies have found that social acceptance is related to broader factors such as perception of fairness or equity (Petrova, 2013; Swofford and Slattery, 2005; Warren and McFadyen, 2010). Ellis and Ferraro (2016) concludes there is a broad consensus that the social reality of local opposition does not align with how local opposition is framed through the concept of NIMBY-ism. Empirical research indicates that negative attitudes towards wind power are primarily based on the perceived visual impact, but that discontent about the decision-making process and the management of facilities is reinforcing the attitude (Breukers and Wolsink, 2007). Local involvement, financially and in decision-making, appears to boost the support of the wind schemes locally (Devine-Wright. 2005; García et al., 2016).

4.1.2. NIMBY-ism and political measures

Whether or not NIMBY-ism is of relevance has an impact on how we try to create a socially more inclusive energy transition. If we only consider NIMBY-ism as the root of opposition, this opens up for very limited changes in policymaking in order to include all parties of society. However, if we consider the lack of local involvement in the planning process of the future energy systems, there are several ways of including the municipalities or local communities in the process. This opens up for a wider discussion about energy justice. Discussing NIMBY-ism and the perception of fairness and equity is more or less limited to a discussion about distributive justice. By recognizing that local participation in the planning process is key to achieve some sort of social acceptance, we are allowed to elaborate the perception of justice and

its importance for social acceptance by including both procedural and recognition justice.

NIMBY-ism has been an important concept in the literature on social acceptance of wind farms. However, less researchers are now listing this as the prime reason for controversies surrounding wind power development. This is furthermore giving more legitimation of the arguments presented by the wind power objectors. Instead of just assuming that opposition to wind power is due to some increased private costs imposed by the siting of the turbine, avoiding NIMBY-ism as an explanation is actually acknowledging that there might be other legitimate problems related to the siting of wind power that are not related to the private costs.

4.1.3. The U-hypothesis and changing opinions

Surveys conducted by Nadaï and Labussière (2009) and Devine-Wright (2005) find that local opposition to wind power projects change significantly during the process of construction. More specifically, there is a higher social acceptance before and after the construction of the wind farm. Or put in other word, social acceptance is decreasing the closer we get to the starting phase of construction, but then the acceptance increases after the project is finished. This argument can be illustrated in the graph seen below taken from Enevoldsen and Sovacool (2016).

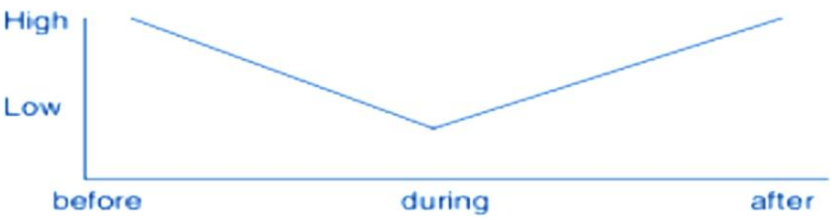

Figure 2. The dynamics of social acceptance in a wind power project. Graph copied from Enevoldsen and Sovacool (2016).

4.2. Common assumptions about wind power opposition

The literature on opposition against wind power has not been able to fully explain why there is a lack of social acceptance in many cases. Aitken (2010) tries to explain

why this might be the case by highlighting some key assumptions that are being made. The five assumption being made are:

1. The majority of the public supports wind power.
2. Opposition against wind power is therefore deviant.
3. Wind power opponents are either misinformed or ignorant.
4. The reason for understanding wind power opposition is to overcome it.
5. Trust is key.

In the next paragraphs I will explain these assumptions in further detail before I go on to explain why these assumptions possibly could lead to very unfair outcomes in terms of energy justice even when all parties are included during the planning process.

4.2.1 The majority of the public supports wind power

Similar to the case in some European countries, there have been surveys and polls showing that the overall support of wind power in Norway is high (Kristiansen 2019; Leiren and Linnerud; 2019). There has however been a recent shift in the attitudes towards wind power and more Norwegians are currently saying that they are opposing it (Aamodt 2019). However, if there's one thing we could learn from these polls and surveys, it is that they might be representative about the attitudes, but that the actual deployment of wind power is way more controversial and might change the attitudes. Hence, if the questions posed in surveys about wind power are not contextualized, it might lead to a misrepresentation about the actual deployment of wind turbines. As Aitken (2010, p. 1835) claims: "Opinion polls can only provide a snapshot of public opinion and are unable to reflect the dynamic, changing character of public opinions." So, as Devine-Wright (2005, p. 135) notes, qualitative methods might be better to investigate "how turbines are symbolically represented across different social groups, within and across communities."

Rather than relying on opinion poll data and surveys, the literature should be based on qualitative analyses. As Aitken (2010, p. 1835) notes, "this is essential for understanding how opinions change over time and how geographical, temporal, socio-political or cultural contexts influence and alter public responses."

4.2.2. Opposition against wind power is therefore deviant

The second assumption listed by Aitken is a direct effect of the first one. The existing literature on wind power tries to explain why, given the fact that the vast majority is in favor of wind power, the implementation of new projects is so problematic. Aitken (2010) argues that these two assumptions encourage simplistic examination of public responses to wind power. NIMBY-ism is a good example of this, because NIMBY-ism is assuming that people in general are supportive of wind power, and that they are only opposing it due to the fact that the wind turbine is sited in close proximity to their own communities.

4.2.3. Wind power opponents are either misinformed or ignorant

The third assumption listed by Aitken is that opposition to wind power arises from ignorance about the actual benefits of the technology (e.g. Ebert, 1999). This is a view that to some extent can be explained from the fact that the opposers are believed to be less legitimate than the supporters, and hence there is a lack of recognition of the arguments posed by the resistance. This view is also reflected in the arguments that greater experience with wind power leads to greater acceptance and consequently that opposition can be explained by ignorance (e.g. Nadaï and Labussière, 2009 and Devine-Wright, 2005). There is some evidence in the literature backing the claim that the social acceptance is increasing with the level of experience with wind turbines, however the explanation must not necessarily be that the opponents are ignorant. It could also be a possibility that the rise in acceptance of wind power after the project is realized is rather a decrease in opposition due to the fact that the local communities, already defeated, may feel that they are not able to further oppose the wind turbines. Hence, there might be several different explanations to this change in public opinion in areas in close proximity to the wind turbines, and we cannot just assume that the reason is ignorance or misinformation.

4.2.4. The reason for understanding wind power opposition is to overcome it

According to Aitken (2010) the literature on social acceptance of wind power exhibits a largely uncritical faith in international and national energy policies. The sole purpose is to find ways to reach the target for emission and deployment of renewable energy set by the national government and international institutions. The

consideration of public attitudes or reactions is thus reduced to the problem of how to mitigate the negative perceptions of wind power in order to ensure greater planning approval (see: Wolsink, 2007; Peel and Lloyd, 2007; Toke, 2002). Hence, there is some sort of lack of acknowledgement that there actually are problems related to the implementation of wind power projects. Without acknowledging that there might exist legitimate reasons for opposing wind power, we will not be able to fully understand the reasons for why local opposition arises.

4.2.5. Trust is key

The final assumption is that by including the local communities in the planning and development process, the opposition will decrease and there will be higher greater rate of planning approval (see: Breukers and Wosink, 2007; Gross, 2007; Wolsink, 2007; Krohn and Damborg, 1999). There is some consensus among researchers that by involving the local communities in the planning and licensing process, it is easier for the local communities to accept the final decision being made.
However meaningful participation in the planning process requires openness and the opportunity for the involved participants to determine and influence the final outcome. If we are already assuming that the opposition against wind power is due to ignorance and misinformation, a fair process will in fact be very difficult to achieve. Here it should also be added that there can be significant heterogeneity in both local communities and the resistance. So, although there is some involvement of local communities in the licensing process, there can still be the possibility that some people or groups are either excluded or ignored in the process due to the fact that they may represent different interests although located in the same geographical area.

4.2.6. Summarizing the main assumptions about wind power opposition

According to Aitken (2010), these assumption goes to show that the literature on social acceptance have fed into one another and ultimately shaped and limited how local communities are perceived during the planning and development process of wind power. The assumption that the majority of the public is in support of wind power technology, creates the belief that wind power opposition is deviant or illegitimate. This then gives us the impression that objectors are ‘wrong’ and can

easily lead to the conclusion that opposition is due to ignorance. The assumption that objectors should be overcome is then obvious. A participatory process based on these assumptions will hence not be meaningful in the sense that the participants have an actual influence in the planning and development phase of a wind farm. The reason for this is that meaningful participation requires openness and the opportunity for the participants to determine and influence the process and outcome, which is hard to achieve when the objectors are believed to be less legitimate.

Hence trust may be of key importance in the planning and development process of wind power. However, in order for trust to be meaningful, it cannot be conceived as a mean in order to justify the end – i.e. less opposition and more wind turbines.

In any case, these assumptions address a lack of both recognition and procedural justice. The lack of recognition justice stems from the fact that the opposition is assumed to be ignorant or misinformed. Hence, the arguments of the objectors are not acknowledged as valid. The lack of procedural justice stems from the fact that the procedure is used as a mean to implement more wind power technology, rather than giving the objectors a real opportunity to influence the final decision in a meaningful way.

I will in the further discussion about implementation of wind power in Norway try to avoid making these assumptions. However, there is no denying that in order to achieve more social acceptance in the matter of wind power, the decision-makers have to include the objectors in the planning and development process. Therefore, it is clear that the decision-makers are doing this to magnify the social acceptance. However, it will be seen in the later discussion that this can be done in a meaningful way if the opposition is included in the process with *actual* and formal power during the discussions.

5. Wind power externalities

Although the costs of developing wind turbines have been declining, there is still a gap between the private and public economics of wind power (Borenstein, 2012). Even though the private costs of wind power are greater than the conventional alternatives, the social cost of those alternatives is presumed to be lower. There are several externalities that we have to consider while examining the effects of wind power. The reason for this is that wind power has impact on society in a lot of

different ways other than just contributing to lower emissions. I will in this section discuss these externalities, which also are commonly used as arguments against wind power in Norway. Of course, there are many things to consider while planning a wind park, and I will not be able to introduce them all. The externalities listed below can be read as the most common counterarguments against wind power. They are also additional costs or benefits to society that the decision-makers or energy-planners have to take into consideration.

5.1. Explaining the concept of externalities

In principle, an externality is an effect, external to the market mechanisms, that influences an individual or agent without being able to control it, by reducing or increasing the utility of that person. In neoclassical economic theory, an externality constitutes a market failure because it creates a wedge between the private costs and the social costs of an alternative. For example, the private costs of buying gasoline can briefly be summarized as the cost of extracting the oil and making it into gasoline, the costs of transportation, paying wages to the workers and so on. However, there are a lot of negative externalities associated with the usage of gasoline. Burning gasoline will for example lead to the emission of greenhouse gases, which have global negative effects on the environment. The externalities in the production and usage of gasoline can be thought of as social costs. Similarly, there are several externalities associated with the construction, implementation, operation and disposal of wind turbines.

5.2. Positive externalities

The indirect effect of wind power includes the avoidance of greenhouse gas (GHG) emissions – although there are emissions happening during the construction and decommissioning of wind power plants and in the extraction of the materials used such as cement (Weisser, 2007). The avoidance of GHG emissions given that we maintain the same level of energy consumption as today stems from the fact that the alternative energy source could be fossil fuels. By using wind power to produce energy, we are thus avoiding the emissions associated with production of energy through the use of fossil fuels. Similarly, it can be argued that by producing energy with wind power, we are reducing or eliminating the risks that are associated with

nuclear power. Hence, the introduction of wind power into the Norwegian society can be thought of as a positive externality to the global society since it helps us reduce the GHG emissions and mitigate the threat of global warming.
Furthermore, there can be positive externalities to a local community associated with the construction and presence of a wind park. E.g. if the wind park is creating new job opportunities and increased income for the municipality, this is a positive externality.

5.3. Negative externalities

First of all, the wind turbines directly affect the habitat for wildlife. Ecological analyses find that mortality for birds and bats is increasing due to wind turbines as a result of collisions (Barclay et al., 2007; Barrios and Rodriguez, 2004; Voigt et al., 2015). Beyond direct mortalities, construction activities and land-changes may also have an impact on the wildlife (Pearce-Higgins et al., 2012). Other researchers have not found a significant impact of wind power on animal life (Devereux et al., 2008). Hence, it might actually be the case that birds are able to adapt to the construction of wind power (Plonczkier and Simms, 2012). It is therefore of importance to consider the possible impact of wind turbines on wildlife before starting a project. It should be done an extensive analysis before a project start, and wind parks should be sited in less areas where wildlife is more vulnerable. In Norway, it is also a problem with the reindeers, an industry that is most commonly associated with the indigenous Sámi people. Reindeers tend to be very ‘shy’ and their habitat is thus largely affected by the increased noise in the presence of the wind turbine.
Secondly, wind farms emit a weak but characteristic noise, and can therefore constitute a negative externality on the people living in close proximity to the wind park (Wang and Wang, 2015). This can furthermore lead to a change in health quality of life due to disturbed sleep or higher levels of distress. It can for example be the case that the annoyance of its visibility can lead to a higher level of stress which also is likely to affect the health. It would be interesting to see how the stress imposed by wind turbines compares to noise from other infrastructure projects. How does for example the argument of increased noise compare to highway or trafficked roads in the cities? Some of the literature also claims that the proximity of a house to a wind turbine is also likely to affect the value of the house, which the house owners evidently could be compensated for (Sim et al., 2010). This is however disputable,

and other research has shown that the effect on the housing prices is marginal at most (Pryce, 2016). This is however very much dependent on the location of the wind turbines. Norway is with a relatively low population density, and we should therefore be able to find remote areas in order to avoid imposing these externalities on people. Thirdly, scenicness and untouched nature is also something that is highly evaluated by residents. Hence, the presence of wind turbines is something that evidently will be a negative externality. Throughout the literature, this is often believed to be one of the main reasons for the opposition of wind power (Wolsink, 2007; Ek, 2005; Jones and Eyser, 2010)

These identified externalities are in line with Zerrahn (2017). We probably could have extended the list even further similar to Zerrahn. There probably exist hundreds of minor and major externalities related to the use of wind turbines. Some of these regarding the construction process of the turbines, while others occur in the presence of wind turbines and some occur in the recycling phase. The ones listed above can to some extent summarize the main concerns about wind power in Norway. It is also important to nuance the discussion by pointing out that the externalities differ from project to project and that that the externalities identified here might be minor or major compared to other infrastructure projects.

6. Wind power in Norway

6.1. Norwegian context

Norway agreed to a target of 67,5% renewable energy by 2020 in total energy consumption in line with the EU's Renewable Energy Directive (Olje- og energidepartementet, 2016). Investments in wind power in Europe is continuing to increase, while costs continue to decrease (Wind power monthly, 2020). Solar and wind power are now two of the most popular choices of technology in Europe in the ongoing transition to a greener energy system. Norway however has been lagging behind in the investments and instalments of wind power. The reason for this is mainly that Norway has a lot of hydropower resources. Wind power is however on the rise in Norway and the recent year's electricity generated from wind power has increased sharply (Inderberg et al., 2019) and there are still several ongoing projects yet to be finalized. Since the first wind park was finalized in Norway in 1998, there

has been granted more than 100 wind power licenses of which 45 has yet to be started (NVE 2020). The falling productions costs makes it more likely that the licenses are going to be used in the coming period. Furthermore, although hydropower is dominating the electricity supply, encouragement of use of other energy sources such as wind power will help Norway to diversify the electric sector by making it less vulnerable to electricity shortage, high prices or periods of less rain/snow.

There has however been a rise in opposition to wind power in Norway the past few years, and this is might slow the process of transitioning down. Recent examples from Norway show there has been destruction of property on the construction sites of wind parks in an attempt to slow down the construction process (Mo 2020; Trana et al. 2019). In a long-term perspective, if there is a shift in the national perception of wind power, which to some extent already is visible (Cicero 2019), one plausible implication might be that the political parties are less willing to advocate for wind power as part of a transition. And thus, we might expect that there will be less development of on shore wind power in Norway in the coming future.

Hence, if the goal is to increase the volume of wind power, it is paramount to ensure social acceptance and recogntition of various groups in due processes. Otherwise, it is possible that the long-term implication of less environmentally friendly, but economically more viable options will be preferred.

6.2. Wind power licensing process in Norway

All wind power projects in Norway where the installed effect exceeds 10 MW requires a license (concession) issued by the Norwegian Water Resources and Energy Directorate (NVE), which constitutes a part of the Ministry of Petroleum and Energy (OED) (Fauchald, 2018). All changes of land-use in the areas designated for the wind power park have to be sanctioned. For all other sectors than energy, this must be sanctioned by the local municipality, with reserve powers for regional and state authorities (Inderberg et al., 2019). The reason for this is that the government sees energy as a crucial sector and thus have to be under state control. Up until 2008, the developers of wind power had to apply to the NVE to get a permit to build a wind turbine and apply to the local municipality for land-use changes. The new Planning

and Building Act (PBA) of 2008 exempted energy installations from these procedures, and today, the energy sector is responsible for sanctioning any changes of land-use.

The official licensing process starts when an energy developer has found a feasible area to build wind turbines and has sent an official notification to the NVE including project plan and proposed mapping. This is the first public announcement that there is a wish to start a wind power project. This notification is then subject to a public hearing, where the NVE opens up for public discussion in the host municipality. This public hearing is to give NVE concrete input about the possible mapping that will be the subject of the Environmental Impact Assessment (EIA). After the public hearing, the wind power developer is responsible for conducting the EIA that will constitute as a part of the application (NVE 2015). When the application is finished and has been submitted, there is a second round of public hearing and meetings (Inderberg et al., 2019).

At this point, if there is “any instance within the public administration that finds the proposed wind power project to be in conflict with its specific field of authority may file a formal objection to the application” (Inderberg et al., 2019). Examples of such actors may be the Sami authorities, environmental authorities or local or regional authorities. The NVE is obliged to organize a mediation meeting if there are any objections raised. If the objection is sustained after this meeting, it will automatically become an appeal if the NVE decides to grant the license.

Any appeal will be sent to the Ministry of Petroleum and Energy (OED). OED will organize meetings with the parties involved in an attempt to mediate one or both (or all) of the involved parties. They might decide to rule in favor of the NVE, or change the decision made, or they may recommend changes in the initial licensing terms given by the NVE (NVE 2015). OED is governed by the cabinet minister, and any final resolution will thus be a political decision. This is in stark contrast to Sweden, where appeals are handled by a court of law (Blindheim, 2015). Furthermore, this is of interest because it implies that the municipalities have no legal power in the process. However, it is seldom that the government approve projects that lack local support.

Now, if the license is granted, then it allows the developer to build and operate a wind power plant. A license usually lasts for 25 years and includes a set of terms that the developer has to consider in the construction and operation phase (Fauchald, 2018). After the 25 years, if the developer wants to continue operation of the wind farm, the developer has to apply for a new license. During this the process to renew the license, an assessment will be made of whether the operation should be allowed to continue or whether the plant should be closed down because of negative local experiences with operation of the wind farm or other changes .Although the licenses given by the NVE differs in many manners, Blindheim (2015) points out the license terms tend to not constitute significant barriers to the developers. This can to some extent be seen as evidence of the NVE's pro-development point of view on wind power. Giving out concessions for 25 years that don't allow for any development may also have very unwanted effects.

6.3. Municipality's involvement in licensing process

Due to the changes in the Plan and Building Act (PBA) in 2008, the host municipality's role in the process is the same as that of any other hearing party in the licensing process. However, Inderberg et al. (2019) argues the actual influence of the host municipality is very different.

First, the developer of the project will normally contact the municipality before the formal licensing process has started. This is also to get a general impression of the municipality's interest in wind power. If the municipality at this stage express that the wind turbines are unwanted, the developer is likely to withdraw the interest, as this serves as a "red flag" about increasing costs and local resistance.
Second, concerning the pre-planning stage, if the local municipality gives the impression of being negative in the hearing process of the notification, developers have indicated that this will most probably halt the project or lead to major modifications of the project (Inderberg et al., 2019).
Third, during the second public hearing that takes place after the Environmental Impact Assessment has been made, the host municipality has some *de facto* municipal veto according to interviews conducted by Inderberg et al. (2019). The

justification for this ‘informal’ municipal veto is considerations of local democracy. Furthermore, municipal opposition could lead to future resistance which likely will make the construction and operation phase much more difficult and costly. It is thus also in the interest of the developer to keep the municipality’s interest aligned with its own. Arguments have also been made regarding the fact that NVE has a high number of pending wind power projects, and thus will prioritize the projects where the municipalities are positive.

The special role given to the municipality in the hearing process shows that different actors are accorded different weight in the final decision made by NVE, even though all actors formally have the same status. The practice of heavy weighting of the municipality does not constitute part of a formal part of the laws but has a normative and political basis in the NVE and OED. This can to some extent be seen in the light of the change in the PBA of 2008, where the local government lost its formal power, which now informally is compensated for with the *de facto* municipality veto. However, interviews conducted by Inderberg et al. (2019) with municipal representatives shows that the representatives assumed that NVE would grant the license even if faced with opposition from the host municipality. This is an indication of that the *de facto* veto power in the licensing process in fact has been so informal that some of the municipalities themselves were unaware of it. Furthermore, this might constitute a democratic problem, because it reduces transparency and predictability in the process. The municipalities with more experience and knowledge about the process are more likely to get their way.

In Norway, unlike in many countries, the licensing process is run by the NVE and OED in cases of appeal, and not by local administrations. The power structure gives both of these authorities a strong mandate to decide the license outcomes. Although their decisions are based on both environmental impact assessments and the stakeholders’ inputs, there is some uncertainty associated with some of the decision due to a lack of transparency and predictability. Although all the documents are published after the license is granted, it might at times be difficult to explain how the different interests are weighted against each other.

6.4. Local involvement in licensing process

The involvement in the licensing process of environmental organs, Sami authorities and individuals from the local community is limited to the two public meetings. The first public meeting gives local groups or the public the opportunity to provide inputs and shape the factors that will be assessed in the coming EIA. All actors are entitled to be heard during this meeting; however, every actor does not count equally. The recent discussions in Norway may serve as a symptom of NVE assessing to low value on untouched nature, people's experience of nature and outdoor life or similarly, that they have weighted the opinions of local environmental groups too little. One of the reasons why NVE might have 'overlooked' the interests of local groups is that there is a difficulty associated with assessing a value on a certain landscape or untouched nature. Especially considering that people may assess different values on different landscapes. It is likely that those who now are the most vocal in their opposition against wind power does so because they assess a very high value to a certain landscape. How to compensate for the changes in nature done in order to achieve the energy transition or how to possibly avoid doing these permanent changes in nature is hard without involving local groups formally in the discussion and decision-making process. The fact is that the local groups may actually have *real* power in the process. The problem might be their perception of the power balance in the process.

Because of the difficulty in assessing value on a specific landscape, there might be problems occurring while comparing the final decisions made by the NVE. In some cases, they might deny an application for a license due to location of eagle-owls in that area, while other applications are approved although there are endangered species located in the area. These types of weighing-decisions may be hard to explain, and the reasoning given by the NVE is often explained by the term "overall assessment." This type of reasoning creates a lack of predictability and transparency in the process that makes the *actual* influence of local groups difficult to understand. It can thus be unclear to the local community how their opinions and point of view are valued in the licensing process.

7. Wind power in Norway: procedural and distributional justice

I will in this section discuss the licensing process and deployment of wind turbines in Norway in terms of energy justice. I will try to identify different parties and how they are affected by the development of wind power. Furthermore, I will try to find some possible reasons to why there has been so much opposition against wind power in the recent times. This will be done by identifying stages of the process that has further changed the distribution of benefits and ills associated with the siting of wind parks. In this discussion, it is an underlying assumption that there is some connection between the perceived justice and social acceptance. There exists evidence from the literature backing this claim (see: Swofford and Slattery, 2010; Kaldellis, 2005; Roddis et al., 2018; Gross, 2017), but there still is more room for understanding this interconnection and the opposition in Norway better.

7.1. Distributional justice

The most clear-cut argument when we talk about distributional justice and wind power is that there is an unfair distribution of the benefits and burdens. The benefits are obviously green energy provided to all of Norway, which is a helpful tool to achieve the transition to a greener energy system. The distribution of the burdens and costs are however very skewed. The people living in the host municipality or in close vicinity of the wind park are believed to carry the burden of wind turbines more than any. This includes increased noise, negative impact on scenicness, less areas available for recreational use, reduced value of houses in close vicinity to wind turbines and more.

There are also benefits associated with wind power. One obvious is the increased municipal budgets due to the property tax. The property tax, although of varying scale, restricted to 0.7 per cent of the installation's predicted value, is one of the clearest economic municipal benefits from wind power projects (Saglie et al., 2020). For a municipality of around 1000 inhabitants and several large wind power facilities, this meant the equivalent of around €2 million per year according to Saglie et al. (2020). This is a major source of income for many municipalities, and may allow them to build new nursing homes, improve the education, improving road security, etc. Saglie et al. (2020) claims that "many municipalities saw the property tax as a

minimum requirement: they saw giving up land for energy production to the national grid as something for which the municipalities should receive compensation." This is in line with the existing literature on economic compensation and social acceptance. Economic compensation is of importance, but it is not likely to transform an overall negative view of wind power into a positive one; it is rather changing the attitudes of the most negative to less negative, and the attitudes of the most positive to even more positive (Warren and McFadyen, 2010; Johansen and Emborg 2018). The long-term effects for economic development of being a "wind power municipality" are also positive, but relatively limited, although this vary a lot between different municipalities (Munday et al., 2011). There is also a limited creation of jobs associated with the installment of wind power (Aldieri et al., 2019). Again, there are examples of municipalities that have had significant positive impacts long term after the installment of the wind power projects (Saglie et al., 2020). For example, there might be big contracts to be won by local companies that can bring in a lot of money and secure jobs for a couple of years. However, in smaller municipalities where there are no companies able to take on these projects, the developers will hire dominant regional or national companies instead (Saglie et al., 2020) and less money will be spent in the host municipality.

Hence, there are positive long-term effects of wind power development for the host municipalities, but the only guaranteed benefit is the property tax. According to Saglie et al. (2020) this has given rise to a specific discussion regarding fairness: *relative fairness.* The concept of relative fairness can be summarized by the fact that the municipalities are now comparing themselves and their wind power projects to other wind power projects in different municipalities or to municipalities hosting hydropower facilities. Municipalities hosting hydropower facilities receive significantly greater compensation than wind power municipalities. The reason for this is that hydropower is still more profitable and efficient than wind power in Norway, and the wind power sector are thus taxed less as an incentive. In retrospect, several municipalities have been disappointed with the benefits resulting from wind power development (Saglie et al., 2020). The results did not correspond to the expectations, and this may have increased the dissatisfaction with the economic distribution in retrospect.

The arguments listed above does show the importance of considering some sort of compensation when discussing the development of new wind parks in Norway. If the local communities and municipalities are supposed to accept interventions in the landscape, they need to believe that they receive some benefits from it. This could be more jobs, increased money to the municipality, increased economic development or similar. The findings from Saglie et al. (2020) from Norwegian municipalities show that economic compensation can directly match the interest of some local actors. So even if the landscape is highly valued, the local actors have an interest of securing jobs, local economic development and a viable tax base in the municipalities. Therefore, it can be possible to compensate the municipality and local communities sufficiently to assure that they will tolerate the development of wind power.

Assuring that the host municipality is sufficiently compensated can be done in a number of ways. García et al. (2016) find that households prefer public compensation to private in rural parts of Norway. Warren and McFadyen (2010) find that community-ownership of windfarms can change the attitudes regarding wind turbines in a community and thereby making people more positive. Johansen and Emborg (2018) find that wind farm co-ownership schemes promote some level of local engagement in wind farm projects among the investors.

7.2. Procedural and recognition justice

Saglie et al. (2020) conducted a study of several municipalities in Norway, where they found that the licensing process was largely perceived as having been fair by those who responded on behalf of the municipalities. So, despite the formally weak inclusion of the municipalities in wind power siting decisions in Norway, there has not been strong municipal opposition against wind power development up until more recently. This might come as a surprise after the changes in land-use legislation reduced the municipalities' formal influence, transferring the decision-making power to the national energy authorities. There is however a broad understanding that local autonomy is of utmost importance in national decision-making in Norway, and most developers are familiar with this (Gjerald, 2012.) This again has led to the early contact between developers and municipalities, ensuring that municipality has a

strong role in the crucial planning stages of the project.

However, one of the reasons why the discussions about wind power in Norway have been so heated recently is that the wind power license permits adjustments to the project plans after the license has been granted. This includes changes made to the height of the wind turbines, the location and the access roads, etc. Such changes can have a big effect on the visibility of the turbines. According to Saglie et al. (2020) several municipalities later regretted not having had more influence during this stage of the process. Thus, the municipalities perceived the procedural fairness as fairly strong throughout the licensing process, but far weaker after the license was granted (Saglie et al., 2020). After the license was granted, several changes were made; the height of the turbines tended to increase, the number of turbines tended to decrease and ultimately, the location of the turbines could change as well. This is furthermore exemplified by the changes in support of wind power of the local politicians in rural parts of Norway (Åsnes et al. 2020).

In term of energy justice, these problems are all addressing the same issue; People feel that their interests in the licensing process have not been heard or taken into consideration for the final decision. This serves as a sign of the lack of *recognition justice* in the implementation of wind power in Norway. One example of this is the adjustments being made. When the license is granted by the NVE, there is not much the local community or municipality can do or say to alter the process. When the local community then decides to oppose the change of plans of height and location of the wind turbines, there is not anything that can be done. The feeling of being excluded and not heard in the process will have a negative effect on the perceived *procedural justice.* It might be that the initial process was perceived as fair, but the altering of the wind turbines that tend to happen years after the license was granted has led to a change in the perception of justice.

The fact that the local communities and host municipalities feel that they are not heard in this part of the process will further decrease the perceived recognition justice. In fact, it might be that the NVE actually understand the problems and acknowledge them, but because there is not much to be done after the license has been granted, they will have to ignore the protests from the local community. This will

again affect the sentiment of procedural justice. As was mentioned earlier, the municipalities were initially feeling fairly treated in the licensing process, but when asked again in retrospect there was a clear change in the attitude (Saglie et al., 2020). This can give rise to a hypothesis about the recent increase in opposition in Norway; when the local communities realize that the wind turbines will increase in height and change location, they go to their democratically elected representatives that they expect are supporting their claim. Now, when the municipalities realize that they are locked by the decision made years ago, both the local communities and the municipality realize that they are in fact not given any power to influence the final design and construction0 of the wind park.

This can be explained as follows, where the increased visibility and noise of the wind turbines leads to an even more unfair distribution of the burdens of wind power (less distributional justice). The exclusion of the municipality in this important phase of the planning lead to a realization that the procedural justice is not as high as expected. And ultimately, this leads to the conclusion that their claim is not acknowledged (less recognition justice). The whole spiral points in one direction: the local communities and their interests are not represented in the process and the distribution of benefits and ills is unfair. This can lead to social unrest and protests.

8. Policy changes

The Norwegian government and the NVE have had no other choice but to acknowledge the problems regarding the development of wind power in Norway. This acknowledgement has therefore quickly been followed up by a series of changes in the policy as a measure to address the problems. I will now go on to discuss the specific policy changes that have been made by the government in an attempt to mitigate the opposition and create a less hostile climate for discussing wind power. I will elaborate to what extent these policy changes have successfully integrated the three tenets of energy justice and what they might have lacked.

8.1. Changing the licensing process

The Norwegian government recently decided to address the problem of increasing heights and switched locations of the wind turbines by altering the licensing process. Realizing that the next couple years there will be an increased development of wind

power in Norway, and furthermore that the on-going discussions in Norway are currently very heated, the government decided to address the lack of procedural and recognition justice by changing the licensing process in June 2020. Developers now have more rigid rules about the siting and height of the wind turbines and a shorter time-limit from the license is granted to the development phase has to be started (OED 2020). This particularly mean that the license set regulations about the height and siting before the development has started. The government also has showed an intent to assess higher value on nature. They also made it a target to increase the municipalities' and local influence, but with no specific action made to target this objective, there is some uncertainty associated with the actual changes in the licensing process with this regard.

The recent change in the licensing process in Norway should be recognized as a first step towards a more just process. As discussed earlier, the changes in the height and location of the wind turbines have left people in the local communities with a feeling of helplessness and a feeling of that their problems and opposition is not acknowledged. By making the laws for wind power development stricter, the government is to some extent recognizing the fact that the initial licensing process had some flaws. This is unlikely to affect the current opposition but is done by the government in order to avoid future situations in which the local communities are left in surprise by the increased height of the wind turbines. To some extent, this change in the laws for wind power development is addressing the above-mentioned issue that the municipalities felt that there was a strong procedural justice during the process itself, but that it was weaker in retrospect after the license was granted. It is thus likely to increase the sentiment of procedural and recognition justice; however, it might not be sufficient in order to assure compliance by the municipalities. Furthermore, the issues of changing heights after the concession has been granted poses a trade-off for the government. On the one hand, rigid restrictions about how much the height of the turbine can change is likely to be welcomed by the local communities because it increases the predictability in the process. On the other hand, it can negatively affect the projects viability because it makes it more difficult for the developer to adapt to new technologies, thereby making the project less profitable. The changes made by the government may thus in fact be understood as

a recognition of the fact that the licensing process may have been too development friendly.

The changes in the laws have been trying to address the problem of what have been perceived as an arbitrary licensing process. This is an attempt of creating more predictability in the process, and thus increasing the procedural justice. To some extent, it seems like there is an attempt of involving the local communities and municipalities in a much more proactive sense. There are however no changes in the formal power given to the municipalities in the licensing process. Although the informal veto power remains, the municipalities are still very much against the fact that energy installations are exempt from the Plan and Building Act. If it were to be included again, like before 2008, this would have given the municipalities a formal position with power in the process. Hence, it would increase the local involvement in the process, which arguably is key in order to achieve social acceptance of wind power. This would have increased both the procedural and recognition justice, and the situation might have been very different today if the municipalities had a formal position in the decision-making process. A lot of the research on acceptance of wind power stresses the importance of local involvement in the process for achieving social acceptance (Swofford and Slattery, 2010; Kaldellis, 2005; Roddis et al., 2018; Gross, 2017). If the case is that the changing height and location of the wind turbines is what initially made people realize that their saying and power in the licensing process was limited and that there was a lack of procedural justice, then the new law for licensing can represent an improvement in the involvement of local actors.

It is thus safe to say that the new law is a step in the right direction in order to achieve both energy justice and social acceptance. It can however be argued that the government is still not addressing the most important problem with the licensing process; the lack of formal power to the municipalities. As of today, even with the new rules, the municipality formally has the same position as any other party that is part-taking in the public hearing. Furthermore, in terms of the common assumptions listed by Aitken (2010), this does not fully fix the problem. It seems to some extent that the changes in the laws have been made mainly to achieve a greater social acceptance. The opposition (for example the municipalities) is still not included in a completely meaningful way into the planning process. They still lack a formal saying

in the matter, and hence, it can be argued that the changes mainly have been done to mitigate the opposition. The arguments of the opposition are still not fully recognized, as they are yet to receive any formal position in the planning process.

At this point in time, where the opposition is so strong, there are almost daily articles and interviews written in the newspapers about wind power projects and their objectors, it is likely that it is not enough to fix the problem from which the opposition originated. Even though the idea behind the original licensing process was that the municipalities were supposed to be an equal party as NVE and the developer in the process, it has backfired and now the issue might rather be that there is a lack of trust to the central authorities and the NVE. One possible way of regaining the trust could be by formally giving the municipalities the power to decide the outcome of any wind power projects themselves.

8.2. Excluding areas

While the discussion about wind power in Norway was at its most heated in 2016, the Norwegian government decided to hand NVE the task of identifying suitable/non-suitable areas for further wind power development. This plan was initiated to reduce the conflicts and increase the predictability and transparency in the NVE decision-making. The plan was introduced in 2019, both with an updated knowledge about what to consider when granting licenses for wind power and introducing 13 areas that according to the NVE were the most suitable for wind power.

The updated knowledge consisted of 21 different reports on different things to consider when giving out licenses to develop wind power. This was done in an attempt to map out all the different interests that are affected by wind power in Norway (e.g. bird life, reindeer, Norwegian army, local communities, bats, cultural landscape) (see NVE Nasjonal ramme for vindkraft 2019). All over Norway, there are opposing interests that the energy system planners have to take into consideration during the planning process of where to site the wind turbines. This updated knowledge then constituted the base for the 13 areas identified as the most suitable for wind power.

By excluding certain parts of the country-side that are believed to have very beautiful landscape, unique nature, are especially important for animal life, reindeer, bird life, or that are too close to the nearest neighbors (and more) would allow us to create a map with least controversial areas in Norway. This is very similar to what NVE did when they created the 13 areas that are most suitable for wind power. This could furthermore create more predictability in the licensing processes and thereby increase the procedural justice. However, although the NVE had tried to remain open to suggestions during the creation of this map, they received nearly 5000 complaints in the period after the plan was presented. Most of them from individuals, but also a clear majority of the affected municipalities remained negative towards the suggested areas. After a couple of months of discussions, the planned mapping of 13 areas was discarded, but the 21 reports are meant to remain the basis for all the future decisions made by the NVE.

Apparently, it could be argued that the mapping made by the NVE was a good idea. This however raises the question of why there were so many complaints about the draft that the government finally decided to reject the 13 areas identified. Some of the opposition probably stems from the fact that it was not well enough communicated what the plan was meant to achieve. People believed it to be a development plan and that the areas identified soon would be filled with wind turbines. Developers believed it to be a protection plan, and that soon all the land outside of the identified areas would be off-limits. The plan was made in order to achieve more predictability in the process. It would still be possible to apply for licenses outside of the identified areas, however, they were more likely to be deprioritized. And the licensing process was still meant to continue the way it is, and hence, it still would have been possible for the local communities and municipalities to protest and oppose the project plans presented by the developers.

There are thus several ways of mapping out the areas most suitable for wind power and other ways will be discussed in section 9. The suggestion made by the NVE, excluding the areas with most wildlife, untouched nature, closest to neighbors, etc. is a good way of acknowledging that it is difficult to assess a value on certain parts of nature. This is a good tool that can be used in order to achieve some justice for parts of nature that don’t necessarily have a saying in the licensing process unless

environmental organizations decide to take up the case. However, we should keep in mind that this map might not be sufficient in order to create an inclusive way of developing wind turbines in Norway, as the current resistance has shown us. The mapping would give a degree of predictability in the process and could thus be increasing the procedural justice, but this is only the case if the local communities and people are included in a meaningful way.

9. What can be done to increase social acceptance?

I will in this section make specific suggestions about what can be done in order to increase social acceptance. Now, it is clear there is some connection between social acceptance and the perception of justice, so any suggestion can address one or both of these aspects of the social dimension. I have also argued that social acceptance and perceived justice is often dependent on the political will to redistribute or include municipalities or local communities into the licensing process. This will therefore also be discussed as it is key to understand what it would take to increase local support in specific cases. Some of the suggestions below will be similar to the changes in the laws done by the NVE discussed in section 8. In the second part of this section I will mention some of the reasons to why we also should keep in mind a more global understanding of energy justice while discussing the case of wind power in Norway.

9.1. Increased compensation or local ownership

Although local involvement in the licensing process is important, there also has been made arguments that the compensation received by the municipality is too small. In order for the local communities and municipalities to accept to a larger extent, the problem of compensation has to be addressed. According to the government, an increased compensation through increased taxes is still to be discussed. This could be done with a tax on natural resources, as is the case with hydropower. Wind power is however still not as cost-efficient as hydropower, and it is thus unlikely that the income to wind power municipalities will equal the income of hydropower municipalities. But by making the monetary difference of being a hydropower vs wind power municipality smaller, it is likely that perceived *relative justice* will become greater and thereby creating greater social acceptance.

By finding the right way to compensate the local communities and municipalities, the support of wind power can increase. Saglie et al., (2020) found that the economic compensation can directly match the interest of some local actors in Norway. The positive externality of wind power in a global perspective due to the reduction in greenhouse gases should be evaluated. If they are believed to be sufficiently big, then increasing the compensation given to local communities or municipalities is one way of ensuring a peaceful transition to an energy system with wind power as a main source. Local ownership has also proved to be a useful tool in order to ensure a peaceful implementation of wind power (Johansen and Emborg, 2018). There should be conducted surveys in the local communities close to the planned wind power projects to see how much they value the scenicness, untouched nature, wildlife and similar in that area. If this is done properly, we will have further insight into what to consider in the licensing process, and furthermore how much we have to compensate in order for the local community to accept the deployment. In either case, the compensation mechanism should not *only* be used as a tool to avoid local opposition. It should be perceived as a tool to increase the distributional justice. To the different groups living close to the wind turbines, it is only fair that they get compensated for the immediate ills they're faced with. If the current tax system isn't ensuring enough compensation for the local communities, then it should be discussed how to improve the tax systems in order to increase distributional justice and thereby increasing the social acceptance.

9.2. Increasing costs

The suggestions above point in the same direction; there has been an underestimation of the costs in the planning process. The consequence of the opposition is that the cost of development of new wind power projects has increased. The mentioned destruction of construction tools in attempts to stall the development of wind turbines is one example. Another one could be the pause in wind power development during the period where the government was deciding on a strategy to reduce the conflicts (Inderberg and Gulbrandsen, 2019). A third example could be that the current political climate has changed, and that more people and political parties are opposing new wind power projects. The long-term effects of an unfair licensing process can thus be critical for the planning of the future energy systems;

the lack of perceived procedural justice in the licensing process gives ground for increasing the costs of developing new wind power projects. Furthermore, we should recognize that there now is a lack of trust to the central authorities and the NVE, and that any mediation done by the central authorities may in fact be perceived as devious. The easiest way of avoiding this situation could be by giving the municipalities complete autonomy in the licensing process. This might represent an increased cost to the government, and there should be done analyses about what is likely to be more expensive: the ongoing protests due to the existing licensing process or giving the municipalities complete autonomy in the decision-making.

There are two ways we incorporate the increased costs into the energy system models. The first is by increasing the assumed construction cost of new wind power projects. The developers could observe the resistance and anticipate that an unfair licensing process and the lack of local compensation could increase the future costs of wind power development. The developer would then face a cost that is more likely to be close to the true cost of developing a wind park in the current climate.
The second way of possibly recognizing that there should be a higher cost in the energy system models is by conducting qualitative interviews with the inhabitants living close to the proposed wind turbines. The spatial difference between costs and benefits is what creates a lot of the opposition against wind power. It might be the case that there has been an underestimation of the costs imposed on the local communities due to misunderstanding the importance of national surveys regarding the attitudes towards wind power. The inhabitants in a municipality with proposed plans of a wind park will compare the costs with the benefits. Their decision of acceptance relies upon the cost associated with having a wind turbine in their local communities, and the present value of the future gain of increased income to the municipality. For the people living outside of the municipality, e.g. in the big cities, the decision will be very different; the cost to these people will probably be much lower, unless they are asserting a very high value to untouched nature or wildlife. This is why surveys measuring the national acceptance of wind power can be so misleading; they do not tell us anything about how strong the opposition is of those with negative attitudes. If the developers were aware of the attitudes towards wind power in a specific region on a local level, it might have been that they earlier on in the process understood that the costs could be rising due to local opposition. Hence, the

developers of wind power in Norway are basing their investment decision on an expected cost that presumably is lower than what the real cost turns out to be. If we had qualitative information about the attitudes towards wind power in specific regions in Norway, this might have been avoided.

9.3. Restrict the feasible areas

One other way of increasing the social acceptance is by creating a map over the most feasible areas with respect to different interests. We could for example map both the areas with the best weather conditions and the areas with the least expected resistance against wind power. More specifically we could create surveys and polls asking people in the local communities about how they would feel about a wind turbine sited in close proximity to their house, what they would feel is an appropriate compensation for such a change in their communities, what areas they use for recreation, and etc. By doing this, we could possibly find the areas that affect people the least in Norway, and these places could be given priority in the licensing process.

However, the goal of any deployment of wind power should not *only* be to find out where people are the least affected. It should also be a goal of creating a fair and just energy transition, so that people are benefitting and paying the costs together. One possible consequence of mapping out areas based on surveys about attitudes such as suggested above is that the burdens of wind power can be very unequally distributed, and in fact magnify social differences. Liljenfeldt and Pettersson (2017) looked at whether the decision to approve or reject wind turbine proposals in Sweden could be explained by factors related to socio-economic characteristics of the people living in close proximity to the suggested wind turbine. The results of their analysis showed a skewness in the distribution of wind turbines, with a higher probability of rejection in areas where people with higher education and people working in the private sector were living. Although the study does not necessarily conclude that the distribution of wind power in Sweden is unjust, this is something to keep in mind in order to prevent a skewness in the distribution of wind turbines. There are several possible explanations to why this is the case in Sweden, but a plausible one is due to the cost and time of fighting the development of wind power. Protests and attempts to obstruct the construction process tend to be costly and long lasting. It is more likely that people with more resources are better equipped to fight of the construction.

This is however only one possible explanation, and there is room for more research about the socioeconomic background of the people fighting of the wind power developers. But in either case, this gives rise to a possibility that the distribution of wind turbines might already be skewed with a higher probability of accept in the areas with inhabitants with lower education and people working in public sector. Basing the future deployment of wind power on a mapping of social acceptance could further skew the distribution of burdens and thus lead to increased inequalities.

9.4. Global considerations and room for further research

There are a lot of possible issues associated with energy production and its impact on fairness and justice (Jones et al., 2015). It is for example often assumed that the costs of climate change will befall on the weakest and least developed countries as well as on the poorest within those countries (Sovacool et al., 2017). As per Sovacool et al. (2017), “energy justice attempts to apply principles and concepts from social justice to the global energy system in its broadest sense. The conceptual framework of energy justice therefore involves burdens, or how the hazards, costs and externalities of the energy system are disseminated throughout society.” Sovacool and Dworkin (2014) argues that underpinnings of “global energy justice” has all been based on Western philosophers and that it thus has an anthropocentric bias, perhaps understandable given the fact that modern energy systems have been built to serve human needs. Thus, the field of energy justice has been focusing a lot on questions of ethics and morality among and between humans. Furthermore, one other weakness with the concept of energy justice is that if it is applied in a national or regional context, we may end up neglecting externalities that happen in the upstream or downstream processes (Sovacool et al., 2020)

Similarly, this report has focused on the national and regional level with regards to the implementation of wind power into the Norwegian energy system. This will in fact lead us to neglecting the social dimensions in a number of ways. I will therefore identify what problems may arise when discussing energy justice in a national and anthropocentric context. Furthermore, I suggest that there is room for more research within this field of energy justice.

9.4.1. Considerations for non-human life

Because the energy systems have been built to serve the needs of humans, it becomes clear that the concept of energy justice thus is rather anthropocentric. On the one hand, it is clear that a transition to a greener energy system also is an advantage for animals, as it hopefully will help us avoid the threats of global warming and the associated extinction of animals due to changes in the climate. On the other hand, the actual deployment of technology can harm animal life, as especially is the case with the deployment of wind power, which by many is found to harm bird life. Hence, in order to achieve energy justice for both humans and animals, we need to make sure that the actual deployment of wind turbines is not harming the environment in any substantial way.

9.4.2. Energy justice in global context

A recent article by Sovacool et al. (2020) looks at the upstream and downstream processes, such as mining or waste flows in the development of low-carbon technologies, such as solar panels or electric vehicles. The international resource panel (2019) recently found that the resource extraction has more than tripled since 1970, and that by 2060, global material use could double. Another consequence of the expansion in low carbon technologies is the significant growth in flows of electronic waste, a toxic waste stream which includes elements such as discarded wind turbine components, electric vehicle batteries, solar panels and etc (Sovacool et al., 2020). The amount of e-waste is steadily increasing of which only about 20% is recyclable. Within these flows there are several components and materials that impose a significant health and environmental harm to the nature or people exposed to them. Hence, there is an unevenness in the production and consumption of e-waste: the main producers are Europe and the United states, whereas the receivers mainly are located in Asia and Africa (Sthiannopkao and Wong, 2013).

Similarly, Sovacool et al. (2020) argues that there also exists such an unevenness in the frontend (extraction of materials or mining) of low-carbon technologies. Furthermore, while studying the social aspects of both the frontend and backend of these technologies, we may be able to identify further externalities happening throughout the lifecycle of a wind turbine. The supposed greenness and cleanness of low-carbon technologies can be questioned in the sense that they rely on “dirty flows

of mineral extraction which only perpetuate neocolonial dependence, economic inequality, and degradation of the environment" (Sovacool et al., 2020). According to the critics, low-carbon technologies constitute a continuation of old patterns of accumulation and degradations, hiding the true costs of consumption while deploying this capital in new "green" markets. (Sovacool et al., 2020). They can even lead to the displacement of vulnerable people from their lands or livelihood. Under such twisted dynamics, proposed solutions, such as renewable energy or electric vehicles, may in fact transform into problems.

In order to achieve a fair and just energy transition, we must therefore identify some of the externalities happening in the frontend and backend of low-carbon technologies. It is possible that there are emissions associated with the process of extracting the minerals and recycling the wind turbines that can affect our belief about how "green" this technology actually is. Furthermore, if the frontend and backend of low-carbon technologies are subject to exploitation of humans, nature and animals, it can further affect how we perceive the hierarchy of different technologies. According to Sovalcool et al. (2020) there are at the two "end-stages" of endstream and upstream processes where emerging low-carbon transitions in mobility and electricity "are effectively implicated in toxic pollution, biodiversity loss, exacerbation of gender inequality, exploitation of child labor, and the subjugation of ethnic minorities."

I believe this will become increasingly important in order to understand how to achieve a fair and just energy transition. I refer to Sovacool et al. (2020) and Sovacool et al. (2017) for further research on the life-cycle assessment of low carbon technology and the inclusion of non-human life in the assessment of energy justice. There is however still room for a lot of research on this field, and it would be interesting with a life cycle assessment of the wind turbines developed in Norway.

10. Discussion: What can energy modelling learn?

The discussions about wind power in this report has thus far mainly been limited to the political will to change licensing process and compensation mechanisms. This serve as a background to demonstrate where parts of the resistance might originate from but does not offer any clear suggestions about how energy system models can

improve on the subject of incorporating a social dimension. I will in this section make some suggestions of what the energy system models can learn from the ongoing discussion about wind power. These suggestions must not be considered as solutions to the lack of a social dimension in the energy system modelling but must rather be thought of as suggestions that energy modelers might want to do further research on in the future.

10.1. Is it possible to decentralize the decision-making process?

It has throughout this report been argued that the centralized decision-making has been one of the reasons to why there is so strong resistance against wind power. It was even suggested above that decentralizing the decision-making and giving the municipalities formal power in the licensing process could possibly help us achieve a more inclusive way of introducing wind power into the energy system. This could however impose a problem for the decision-makers as it likely would reduce the feasible areas for development of wind power, and possibly also could increase the costs of implementation. The arguments presented by the government is that the energy system is of national importance and decentralizing the decision-making process might be a step to mitigate the resistance, but it might however also make it more difficult for central authorities to change the current energy system.

In the current situation, it is not unlikely that a decentralization of the decision-making process will have an immediate effect of there being less deployment of new wind parks. However, if this is the case, then it might be a sign of that the current costs of being a wind power municipality are exceeding the benefits. Or put differently, the economic benefits of becoming a wind power municipality might have been too small to incentivize municipalities. A thorough analysis should be done in order to find how much the deployment of wind power possibly could be limited by decentralizing the decision-making process under the current system of compensations. If this imposes a big difficulty for the decision-makers, it might be possible to find other ways to increase the social acceptance, e.g. increasing the compensations received by the municipalities.

This report has throughout argued that decentralizing the decision-making process could be a quick fix in order to regain the trust of local communities. It could however

also be argued that this is a simplification, and furthermore that this would make our energy systems less centralized and thereby also less secure and reliable (due to less diversification in energy sources). Energy is a matter of national interest, and it is therefore not an unreasonable argument that it is subject to some form of centralized decision-making.

10.2. Contextualized surveys

While discussing the resistance against wind power in Norway, it becomes clear that there are some local groups that are having a stronger sentiment about wind turbines than people in more urban parts of Norway. These groups might be relatively small and even seem irrelevant, but because their sentiments are so strong, they can in fact affect the national deployment and public opinion about wind power. This might partly explain what can be described as the recent upspring in opposition against wind power.

We have already discussed the problems of surveys that attempt to find the attitudes about wind power in Norway without contextualizing the implementation. Given that the current resistance to some extent has come as a surprise to the NVE, it is probable that the NVE initially assumed a higher degree of social acceptance. Based on these observations, future surveys and research about the attitudes toward wind power should avoid solely relying on national quantitative surveys, and rather attempt at catching the opinions of those who are the most affected locally. This can be done by contextualizing the surveys, or make sure that extensive analyses about the local attitudes are done before a license is granted. This could create a higher degree of predictability for both the NVE and the developer as it could foresee potential uprising of resistance, and thereby predict a cost that is more likely to be close to the real cost of development.

Therefore, the assumption that the majority is pro wind power can bias the solutions presented by the energy modeling. The energy modelling can for example end up suggesting deployment of wind turbines within reindeer herding lands among the indigenous Samii population, thereby excluding or ignoring Samii interests' in the agenda fighting climate change (Normann, 2020).

10.3. Choice of discount rate

It was discussed in the beginning of this report how the use of different discount rates may in fact lead to very different outcomes in the energy modelling. It was furthermore mentioned that the government now want to assess a higher value on nature in the licensing-process, which may in fact mediate some of the problems regarding the spatial difference between costs and benefit. Now, because the concept of social discount rate is an attempt to reflect the social view on how the future should be valued against the present, an increased weighting of nature in the licensing process could be done by increasing the social discount rate. Increasing the social discount rate is equivalent to increasing the cost of implementing new technologies, thereby most likely making the development rate of low-carbon technologies in Norway slower.

The social discount rate is meant to set a present value on the costs and benefits that will occur at a later point in time. However, while facing an uncertain future, choosing the wrong social discount rate may bias the solutions presented in the energy modeling towards certain technologies. But changing the social discount rate would also have the implication of changing the costs for all technologies. This is because a change in the social discount rate is equivalent to a change in the relative valuation of present and future. It is therefore not a desired solution to change the social discount rate.

One other solution could be to change the implicit discount rate. Schleich et al. (2016, p. 328) identifies three broad categories of factors underlying the implicit discount rates: “(i) preferences such as time preferences, risk preferences, reference-dependent preferences, and pro-environmental preferences; (ii) predictable (ir)rational behavior such as bounded rationality, rational inattention, and behavioral biases such as present bias, status quo bias or probability distortion; and (iii) external barriers such as […] lack of information or limited access to capital.” Since all of these components tend to vary between people, it is safe to say that there is a heterogeneity in the implicit discount rate. Furthermore, it also makes it challenging to interpret the implicit discount rate because it is difficult to isolate one element form another, e.g. isolate the time preference from risk preference. Similarly, a high implicit

discount rate for wind power can be due to considerations about nature, or it could be due to a present bias. Assuming a homogeneous discount rate for consumers or producers and that it is constant for all technologies may be too much of a simplification.

In terms of modelling the actual human behavior, there might be room for allowing the implicit discount rate to vary between households of different characteristics, and technologies. The pro green technologies attitude that surveys have shown in Norway might be telling that the implicit discount rate is low for many households. This does however not extend to the case of wind power, as other considerations regarding the development of wind power could imply a higher discount rate. However, by allowing for a segmented discount rate, we could include the locals into the energy system modelling by integrating their higher discount rates. Failure to account for the heterogeneity in implicit discount rates might actually be what biases the solutions presented in the energy modelling because we are not incorporating the higher cost that the local communities often are assumed of facing.

10.4. Scenario analyses

The energy system modelling is building on several different scenarios regarding the costs of the technologies. Some of these scenarios might vary from an overly optimistic prediction of the future costs of developing the technology, whereas others are more conservative in their predictions. By using the scenario analysis, the decision-makers should be able to adjust according to changes in prices. The sharp decrease in the costs of developing wind farms during the past few years have made the proposed projects in Norway even more profitable. In the energy modelling this change of costs should be reflected in one of the possible scenarios, and hence assure some adaptability in the implementation of the new technologies.
It is however a problem when there is a lag between the licenses granted and the actual development of wind turbines. Many of the licenses that have been granted in Norway happened at a point in time when the cost of development was much higher than it is today, and the decision-makers are thus not able to adjust for the sharp decrease in costs due to the long time span of the licenses. Either way, energy system modelling is trying to predict an uncertain future, and making multiple

scenarios will make it easier to make adjustments to unforeseen changes in human behavior, prices, technologies and etc.

10.5. Summary of lessons to be made

All the suggestions listed above are similar in the sense that they point to the fact that we have not been able to capture the heterogeneity of individuals or groups in the energy modelling, or put differently, we have not been able to incorporate the local communities' and peoples' preferences. There is heterogeneity in the local communities as well, so Similar to the assumptions listed by Aitken (2010), the assumption that Norwegians are pro green technology and that wind power is such a green technology has made the energy system biased towards a high development rate of wind power. Furthermore, the assumptions about rational human behavior combined with the assumption that the majority of Norwegians are pro wind power may lead to a situation where we perceive wind power resistance as irrational. In the existing energy system models, we have not been able to capture the rationality of wind power opposition, and I therefore suggest ways we might be able to integrate these preferences into the models.

The first suggestions for future energy system planning is either to contextualize surveys about wind power so that we possibly could move away from the common perception that the majority supports wind power. Another possibility could be to map out areas where the local communities are more open to development of wind power. This must however be done in a careful manner since preferences might be dependent on socio-economic situation in itself. The third and probably most important suggestion is to allow for heterogeneity in the models by segmenting the implicit discount rate with respect to different technologies and households. Because the implicit discount rate captures preferences with regards to risk preferences, time preferences, environmental preferences and etc., heterogeneity in the implicit discount rate could potentially allow us to use much more realistic assumptions about human behavior. This could allow us to incorporate the local communities' and peoples' preferences. However, because the solutions suggested by the energy system models tend to be reliant on the choice of discount rate, it is still important to extensively analyze how different discount rates potentially could change the solutions. The fourth suggestion is rather trivial to energy system planners but is a

reminder of the importance of considering several plausible and implausible scenarios while planning the future energy system. This is because it will make it easier to adjust to unforeseen changes in the energy system as the recent drop in costs of developing wind turbines, or like the upspring in resistance against wind power.

The above-listed suggestions try to address the fact that some preferences might have been neglected in energy system models while making simplification about human behavior. This is also one of the reasons to why the resistance against wind power may have come as a big surprise to many. In order to incorporate more information about the individual preferences, we need to create more extensive surveys about the preferences so that we can identify households with similar discount rates or similar attitudes towards specific technologies and allow for these groups to be segmented in the energy system models. This might allow us to identify how certain groups might affect the existing energy system.

11. Summary

11.1. Summary of wind power in Norway

It becomes clear that the opposition against wind power in Norway has been steadily increasing due to a lack of predictability and transparency in the licensing process. Most of the municipalities initially agreed to the development of wind turbines. The *de facto* veto power possessed by the municipalities in the licensing process has in fact been so informal that some of the municipalities were not completely aware of it. So, although the municipalities initially agreed to the wind parks, the weak formal inclusion of the municipalities in the process might be one reason the opposition has been increasing recently.

Furthermore, the huge time span between the granting of the license and the actual development of the project, implies that the actual development of the wind parks is happening in a very different political climate then when the licenses were granted. The technology of the wind turbines has changed drastically the past few years, and there has been a sharp decrease in the costs of development. The NVE has chosen to be pro-development in the licenses granted and allowed for several changes made

by the developer in order to use the newest technology in the most efficient way. This, and the decreasing costs of development has both led to an extensive deployment of wind turbines in Norway recently. On the one hand the pro-development attitude from the NVE opens up for a higher efficiency and fewer wind turbines. Since climate action is much more urgent today than it was a few years ago, the pro-development attitude from the NVE might therefore also be a good thing, because it allows us to more rapidly and efficiently implement green technologies. On the other hand, it can be argued that this has backfired and that some of the recent opposition can be explained by the changes made in height, location and deployment rate.

In either case, some of the opposition against wind power in Norway reflects the lack of perceived procedural and recognition justice in the licensing process. This problem has been identified by the Norwegian government and addressed with a change in the licensing process. The new licenses are more rigid and do not allow severe changes in the turbines. This is likely to increase the procedural and recognition justice to some extent, however, as mentioned, the political climate for wind power has changed, and it is unlikely that this change in the licensing process alone can drastically change the opinion of so many objectors. The problem has also tried to be addressed with the national plan identifying 13 areas most suited for wind power. However, it can be argued that the NVE was not communicating well enough what the plan was meant to achieve, which was meant to increase the predictability and transparency and thereby increase procedural and recognition justice.

More than anything, it is the spatial difference between costs and benefit that affects public acceptance. In order to achieve a higher degree of social acceptance of wind turbines in the landscape, we must manage to reduce this disparity by letting the most affected individuals to benefit from the turbines. This benefit can take form in a number of ways; joint ownership of the wind parks, profit sharing or by adjusting the local property tax. It is also important that these individuals also feel included in a meaningful way, and not just as an obstacle for development. A possible change in policies in order to increase the local compensations received by the municipalities and local communities is still to be discussed by the government.

Although there have been attempts at increasing both the procedural and recognition justice through addressing specific problems with the licensing process, there has been no attempts at all three tenets of energy justice simultaneously. More specifically, there has not been good attempts at addressing the unfair distribution of ills and benefits, nor to integrate the municipalities in a more formal way in the licensing process. If we are to achieve a fair and just way of introducing wind power into the energy system in Norway, it is important that those who are more exposed to the ills of wind power have to feel that their voice is heard and considered. There should be made attempts at improving the licensing process and distribution of ills and benefits simultaneously.

10.2. Lessons for decision-makers

As long as the problems identified above are not addressed, the decision-makers should be able to recognize that the cost of constructing wind parks most likely will exceed the private costs that the developers are facing. In retrospect, it might be easy to see that there have been several problems associated with the development of wind parks in Norway. In real time, it is however difficult to foresee such problems. This is one of the reasons why decision-makers have to be thorough in their creation of different scenarios. Creating a big pool of different scenarios with respect to future technological development, future costs, future attitudes and etc. might make the decision-makers more adaptable to unforeseen changes. It is of utmost importance to ensure some adaptability in the transition if they want to incorporate a social dimension into the energy system models. The opposition against wind power has been growing gradually in Norway, and because the licenses have a long time-span, it has left the decision-makers with little room to address the problems.

More importantly, the recent discussion about wind power in Norway should provide us with an example of how complex energy systems are. The opposition in Norway increased as a direct result of the national authorities and the NVE being unaware or ignorant about the local costs, or that they in fact assumed local attitudes were positive. This may however immediately rise the question; if we overestimated the support of the local communities of wind parks, what other biases might we have in favor of wind parks? An important reason to why the local communities and national

groups against wind power now are being acknowledged is that they have been so vocal in their protests. Therefore, we should ask ourselves if there are any other groups that may oppose wind power, but don't have the opportunity to be as vocal as the local communities in Norway have been.

One brief example of this could be the externalities happening in the construction and recycling of wind turbines. It was referred to an article by Sovacool et al. (2020) showing that the frontend and backend of low-carbon technologies could be associated with exploitation of humans, nature and animals. These are voices that probably are less likely to be heard in the ongoing discussions about wind power in Norway. Thus, it is even more important that we acknowledge the problems associated with wind turbines in a global perspective. In order to do this, it might an idea to include the upstream and downstream processes of wind turbines into the climate accounting while comparing different technologies. There is hence room for improvement and further research within this field. Discussing the implementation of wind power in Norway within the framework of energy justice applied throughout this report may lead to very different conclusions about what the decision-makers should do.

11. References

Aamodt, C.C. 2019, “60 % av befolkningen er imot bygging av vindkraftverk som medfører betydelige inngrep i urørt natur, i følge undersøkelse utført for DNT.” *Enerwe*: 24.05.19. URL: https://enerwe.no/60--av-befolkningen-er-imot-bygging-av-vindkraftverk-som-medforer-betydelige-inngrep-i-urort-natur-i-folge-undersokelse-utfort-for-dnt/320608

Aitken, M. (2010), “Why we still don’t understand the social aspects of wind power: a critique of key assumptions within the literature.” *Energy Policy*, 38, Pages 1834-1841

Aldieri, L., J. Grafstrom, K. Sundstrom, C.P Vinci (2019), “Wind power and job creation.” *Sustainability*, *12*, 45

Anthoff, D., R.S.J. Tol, G. Yohe (2009), “Discounting for Climate Change.” *Economics: The Open-Access*, Open-Assessment E-Journal, Vol. 3, 24

Bale, C.E., L. Varga, T.J. Foxon (2015), “Energy and complexity: New ways forward.” *Applied Energy*, 138(0): Pages 150-159

Barclay, R.M., E. Baerwals, Gruver J. (2007), “Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height.” *Can. J. Zool*., 85, Pages 381-387

Barrios, L., Rodriguez A. (2004), “Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines.” *J. Appl. Ecol*., 41, Pages 72-81

Blindheim, B. (2015), “Gone with the wind? The Norwegian licencing process for windpower: does it support investments and the realisation of political goals?” *Int. Sustain. Energy Plan. Manage.*, 5, Pages 15-26

Borenstein, S. (2012), “The private and public economics of renewable electricity generation.” *J. Econ. Perspect*., 26 (1), Pages 67-92

Breukers, S., M. Wolsink (2007), “Wind power implementation in changing institutional landscapes: an international comparison.” *Energy Policy*, 35 (5), Pages 2737-2750

Cicero, 2019. “Klimaundersøkelsen 2018.” URL: https://www.cicero.oslo.no/no/klimaundersokelsen-2018

Collins, M., R. Knutti, J. Arblaster, J.-L. Dufresne, T. Fichefet, P. Friedlingstein, X. Gao, W.J. Gutowski, T. Johns, G. Krinner, M. Shongwe, C. Tebaldi, A.J. Weaver and M. Wehner (2013), “Long-term Climate Change: Projections, Commitments and Irreversibility.” In: *Climate Change 2013*: The Physical Science Basis. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Daum K, Stoler J, Grant RJ (2017), “Toward a more sustainable trajectory for E-Waste policy: a review of a decade of E-Waste research in Accra, Ghana.”*Int J Environ Res Public Health* 14(2):135

DeCarolis, J., H. Daly, P. Dodds, I. Keppo, F. Li, W. McDowall, et al. (2017), “Formalizing best practice for energy system optimization modelling” *Appl Energy*, 194, Pages 184-198

Devereux, C.L., M.J. Denny, Whittingham M.J. (2008), “Minimal effects of wind turbines on the distribution of wintering farmland birds.” *J. Appl. Ecol*., 45 (6)

Devine-Wright, P. (2005), “Beyond NIMBYism: towards an integrated framework for understanding public perceptions of wind energy.” *Wind energy*, 8, Pages 125-139

Ebert, P.R. (1999), “Stakeholder Management” Ignore it and your wind farm may never happen.” In: Proceedings of the 1999 Australian Wind Energy Conference, Pages 44–50

Ek, K. (2005), “Public and private attitudes towards “green” electricity: the case of Swedish wind power.” *Energy Policy*, 33, Pages 1677-1689

Ellis, G., G. Ferraro (2016), “The social accptance for wind energy.” JRC Science for policy report, European Commision

Enevoldsen, P., F.H. Permien, I. Bakhtaoui, A.K. von Krauland, M.Z. Jacobson, G. Xydis, B.K. Sovacool, S.V. Valentine, D. Luecht, G. Oxley (2019), “How much wind power potential does Europe have? Examining European wind power potential with an enhanced socio-technical atlas.” *Energy Policy*, 132, Pages 1092-1100

Enzler, H.B., A. Diekmann, R. Meyer (2014), “Subjective discount rates in the general population and their predictive power for energy saving behavior.” *Energy Policy*, 65, Pages 524-540

Fauchald, O.K. (2018), “Konsesjonsprosessen for vindkraftutbygginger – juridiske rammer.” *FNI Report* 1/2018

García, J.H., T.L. Cherry, S. Kallbekken, A. Torvanger (2016),«Willingness to accept local wind energy development: does the compensation mechanism matter?”*Energy Policy*, 99, Pages 165-173

García-Gusano, D., K. Espegren, A. Lind, M. Kirkengen (2016), “The role of the discount rates in energy systems optimisation models.” *Renew Sustain Energy Rev*, 59, Pages 56-72

Gilbert, A.Q., B.K. Sovacool (2016), “Looking the wrong way: Bias, renewable electricity, and energy modelling in the United States.” *Energy,* Volume 94, Pages 533-541

Gjerald, O. (2012), “Frå Forretningsidé til Realisering for Norske Vindkraftprosjekt: er Konsesjonsprosessen ei Hindring for Norsk Vindkraftutbygging?” *Nordiske Organisasjonsstudier* 14 (1), Pages 51–76

Gross, C. (2007), “Community perspectives of wind energy in Australia: The application of a justice and community fairness framework to increase social acceptance”. *Energy Policy*, 35, Pages 2727–2736.

Heffron, R.J., D. McCauley (2017), “The concept of energy justice across the disciplines.” *Energy Policy*, 105, Pages 658-667.

Hermelink, A.H., D. de Jager, (2015), “Evaluating our future modelling. The crucial role of discount rates in European Commission energy system modelling”. Stockholm, Berlin: *European Council for an Energy Efficient Economy*, Ecofys.

Hoekstra, A. (2018), “Photovoltaic growth: reality versus projections of the International Energy Agency – with 2018 update.” *Marten Steinbuch blog*: 19/11/18. URL: https://maartensteinbuch.com/2017/06/12/photovoltaic-growth-reality-versus-projections-of-the-international-energy-agency/

Hunter S. and Leyden K.M. (1995), “Beyond NIMBY: explaining opposition to hazardous waste facilities.” *Policy Studies Journa*l 23, Pages 601–19

Hursh, S. R. (1984), “Behavioral economics.” *Journal of the Experimental Analysis of Behavior* 42:435–52.

Inderberg, T.H.J., L.H. Gulbrandsen (2019), “Dårlig idé å skrote Nasjonal ramme for vindkraft.” Kommunal rapport: 27/09/19 URL: https://www.kommunal-rapport.no/debatt/darlig-ide-a-skrote-nasjonal-ramme-for-vindkraft/110634!/

Inderberg, T.H.J., H. Rognstad, I. Saglie, L.H. Gulbrandsen (2019), “Who influences windpower licensing decisions in Norway? Formal requirements and informal practices.” *Energy Research & Social Science,* Volume 52, Pages 181-191

Close International Resource Panel (2019), “Global resources outlook 2019: natural resources for the future we want.”URL: http://www.resourcepanel.org/reports/global-resources-outlook.

Jenkins, K., D. McCauley, R. Heffron, H. Stephan, R. Rehner (2016), “Energy justice: A conceptual review.” *Energy Research & Social Science* Volume 11, January 2016, Pages 174-182

Johansen, K., Emborg, J. (2018), “Wind farm acceptance for sale? Evidence from the Danish wind farm co-ownership scheme.” *Energy Policy*, 117, Pages 413-422

Jones. B.R., B.K. Sovacool, R.V. Sidorstov (2015), “Making the Ethical and Philosophical Case for ‘Energy Justice.” *Environ. Ethics*, 37 (2), Pages 145-168

Jones, C.R., Eiser J.R. (2010), “Understanding ‘local’ opposition to wind development in the UK: how big is a backyard?“ *Energy Policy*, 38, Pages 3106-3117

Kaldellis, J.K. (2005), “Social attitude towards wind energy applications in Greece.” *Energy Policy*, 33 , Pages 595-602

Keith, D., J. DeCarolis, D. Denkenberger, D. Lenschow, S. Malyshev, S. Pacala, and P. J. Rasch (2004), “The influence of large-scale wind power on global climate.” *Proc. Natl. Acad. Sci. U.S.A*. 101, Pages 16115-16120

Kringstad, K., E. Sandmo, 2020.“To personer siktet etter skadeverk for 15 millioner kroner i vindkraftanlegg.” *NRK*: 01/04/20. URL: https://www.nrk.no/trondelag/to-personer-siktet-etter-skadeverk-for-15-millioner-kroner-i-vindkraftanlegg-pa-froya-i-trondelag-1.14968801

Kristianse, A.A., 2019. “Flertallet sier ja til vindmøller i norsk natur.” *Dagbladet:* 05/08/19. URL: https://www.dagbladet.no/nyheter/flertallet-sier-ja-til-vindmoller-i-norsk-natur/71457782

Krohn, S., S. Damborg (1999), “On public attitudes towards wind power.” *Renewable Energy*, 16, Pages 954-960

Leiren, M.D., K. Linnerud, 2019, “Lokale forhold og prosess avgjør holdninger til vindkraft.” *CICERO*: 04/03/19. URL: https://cicero.oslo.no/no/posts/klima/lokale-forhold-og-prosess-avgjor-holdninger-til-vindkraft

Liljenfeldt, J., Ö. Pettersson (2017), “Distributional justice in Swedish wind power

development – An odds ratio analysis of windmill localization and local residents' socio-economic characteristics." *Energy Policy*, 105, Pages 648-657

Lund, H., F. Arler, P.A. Østergaard, F. Hvelplund, D. Connolly, B.V. Mathiesen, et al. (2017)*, "*Simulation versus optimisation: theoretical positions in energy system modelling." *Energies*, 10 , Pages 840

Mattmann, M., I. Logar, Brouwer R. (2016), "Wind power externalities: a meta-analysis." *Ecol. Econ*., 127, Pages 23-36

McAvoy G.E. (1998), "Partisan probing and democratic decisionmaking: rethinking the NIMBY syndrome." *Policy Studies* 26, Pages 274–92

McCauley, D., R.J. Heffron, H. Stephan, K. Jenkins (2013), "Advancing energy justice: the triumvirate of tenets", *International Energy Law Review*

McCauley, D. (2018). "Energy Justice : Re-Balancing the Trilemma of Security, Poverty and Climate" Change (1st ed. 2018. utg.). Cham: Springer International Publishing : Imprint:Palgrave Macmillan.

Meyerhoff, J., C. Ohl, and V. Hartje (2010). "Landscape externalities from onshore wind power." *Energy Policy*, 38(1), Pages 82–92.

Mo, A. (2020), "Protesterte mot vindmøller med hakekors," NRK Innlandet: 03/07/20. URL: https://www.nrk.no/innlandet/protesterte-mot-vindmoller-med-hakekors-1.15038852

Mullainathan, S., R.H. Thaler (2001), "Behavioral Economics." International encyclopedia of the social and behavioral sciences, volume II. Oxford: Pergamon,, Pages 1094–99.

Munday, M., G. Bristow, R. Cowell (2011), "Wind farms in rural areas: how far do community benefits from wind farms represent a local economic development opportunity?"*J Rural Stud*, 27 , Pages 1-12

Nadaï, A., O. Labussière (2009), “Wind power planning in France (Aveyron), from state regulation to local planning.”*Land Use Policy*, 26, Pages 744-754

Newell, R.G., J. Siikamäki (2015), “Individual time preferences and energy efficiency” *Am. Econ. Rev*., 105 (5) , Pages 196-200

Nordhaus, W.D. (1997), “Discounting in economics and climate change; an editorial comment”. *Clim. Chang.* 1 37, Pages 315–328

Nordmann, S. (2020), «Green colonialism in the Nordic context: Exploring Southern Saami representations of wind energy development.» *J Community Psychol.* 1–18. Pages

NVE (2015). “Konsesjonsbehandling av vindkraftutbygging.” Updated: 17/06/19. URL: https://www.nve.no/konsesjonssaker/konsesjonsbehandling-av-vindkraftutbygging/

NVE (2018). «Kostnader for kraftproduksjon 2018.» URL: http://publikasjoner.nve.no/faktaark/2019/faktaark2019_07.pdf

NVE (2019). “Forslag til nasjonal ramme for vindkraft.” Oslo: 2019. URL: http://publikasjoner.nve.no/rapport/2019/rapport2019_12.pdf

NVE (2020). “Ny kraft: Endelige tillatelser og utbygging: Første kvartal 2020.” URL: http://webfileservice.nve.no/API/PublishedFiles/Download/201202014/3142631

Olje- og energidepartementet. “Kraft til endring — Energipolitikken mot 2030” St. meld. nr. 26 (2015-2016), Oslo: OED, 2016. URL: https://www.regjeringen.no/no/dokumenter/meld.-st.-25-20152016/id2482952/

Olje- og energidepartementet. “Vindkraft på land — Endringer i konsesjonsbehandlingen” St. Meldd. 28 (2019–2020), Oslo: OED, 2020. URL: https://www.regjeringen.no/no/dokumenter/meld.-st.-28-20192020/id2714775/?ch=1)

Pearce-Higgins, J.W., L. Stephen, A. Douse, Langston R.H. (2012), “Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis.” *J. Appl. Ecol*., 49 Pages 386-394

Peel, D., M.G. Lloyd (2007), “Positive planning for wind-turbines in an urban context.” *Local Environment: The International Journal of Justice and Sustainability*, 12 (4), Pages 343-354

Petrova, M. (2013), “NIMBYism revisited: public acceptance of wind energy in the United States WIREs.” *Clim Chang*, 4 , Pages 575-601

Pfenninger, S., A. Hawkes, J. Keirstead (2014), “Energy systems modeling for twenty-first century energy challenges.” *Renew Sustain Energy Rev*, 5 (33), Pages 74-86

Plonczkier, P., I.C. Simms (2012), “Radar monitoring of migrating pink-footed geese: behavioural responses to offshore wind farm development.” *J. Appl. Ecol*., 49, Pages 1187-1194

Pryce, G. (2016), “Why do wind farms drag down house prices in some places but not others?” *The Conversation:* 19.10.16 URL: https://theconversation.com/why-do-wind-farms-drag-down-house-prices-in-some-places-but-not-others-67329

Roddis, P., S. Carver, M. Dallimer, P. Norman, G. Ziv (2018), “The role of community acceptance in planning outcomes for onshore wind and solar farms: an energy justice analysis.” *Appl Energy*, 226, Pages 353-364

Saglie, I., T.H.J. Inderberg, H. Rognstad (2020), “What shapes municipalities’ perceptions of fairness in windpower developments?”*Local Environment* Vol 25 2, Pages 147-161

Sari, R., E. Voyvoda, M. Lacey-Barnacle, E. Karababa, C. Topal, D. Islambay (2017), “Energy justice.” *ShapeEnergy: a social sciences and humanities cross-cutting theme report*, Pages 2

Schleich, J., X. Gassmann, C. Faure, T. Meissner (2016), “Making the implicit explicit: a look inside the implicit discount rate.” *Energy Policy*, 97, Pages 321-331

Schleisner, L. (2000), “Life cycle assessment of a wind farm and related externalities.” *Renew Energy*, 20 (3), Pages 279-288

Schlosberg, D. (2003), “The justice of environmental justice: Reconciling equity, recognition, and participation in a political movement” *in* Andrew Light and Avner de Shalit*, (eds.), Moral and Political Reasoning in Environmental Practice*, Cambridge, MA: MIT Press

Sthiannopkao, S., M.H. Wong (2013),“Handling e-waste in developed and developing countries: initiatives, practices, and consequences.” *Sci. Total Environ*., 463-464, Pages 1147-1153

Sim, S., P. Dent, R. Oskrochi (2008), “Modelling the impact of wind farms on house prices in the UK.” *International Journal of Strategic Property Management*, 12, Pages 251-269

Smith, K.R., M.A. Desaia, J.V. Rogers, R.A. Houghton (2013), “Joint CO2 and CH4 accountability for global warming.” *Proceedings of the National Academy of Sciences*. Early Edition, July 11.

Sovacool, B.K. (2013), “Energy & Ethics: justice and the Global Energy Challenge Palgrave”, Basingstoke, UK/New York, USA

Sovacool, B., R. Heffron, D. McCauley, A. Goldthau (2016), “Energy decisions reframed as justice and ethical concerns”. *Nat Energy* 1, 16024

Sovacool, B.K., M.H. Dworkin (2014), “Global Energy Justice: Problems, Principles,

and Practices.” CUP, Cambridge

Sovacool, B.K., A.Q. Gilbert, D. Nugent (2014), “An international comparative assessment of construction cost overruns for electricity infrastructure.” *Energy Research & Social Science,* Volume 3, Pages 152-160

Sovacool, B.K., M.A. Munoz Perea, A.V. Matamoros, P. Enevoldsen (2016), “Valuing the manufacturing externalities of wind energy: assessing the environmental profit and loss of wind turbines in Northern Europe.” *Wind Energy*, 19 (9), Pages 1623-1647

Sovacool, B.K., M. Burke, L. Baker, C.K. Kotikalapudi, H. Wlokas (2017), “New frontiers and conceptual frameworks for energy justice.” *Energy Policy Volume* 105, Pages 677-691

Sovacool, B.K. (2017), “Contestation, contingency, and justice in the Nordic low-carbon energy transition.” *Energy Policy*, Pages 569-582

Sovacool, BK., Hook, A., Martiskainen, M et al. (2020), “The decarbonisation divide: Contextualizing landscapes of low-carbon exploitation and toxicity in Africa.” *Global Environmental Change*, 60, Pages 1–19

Stadelmann M., (2017), “Mind the gap? critically reviewing the energy efficiency gap with empirical evidence.” *Energy Res. Soc. Sci*., 27 , Pages 117-128

Stern, N. (2006), “The Economics of Climate Change: The Stern Review.” Cambridge University Press: Cambridge, Volume 30

Swofford, J., M. Slattery (2010), “Public attitudes of wind energy in Texas: local communities in close proximity to wind farms and their effect on decision-making.” *Energy Policy*, 38 (5) , Pages 2508-2519

Todd, H., and C. Zografos (2005), "Justice for the Environment: Developing a Set of Indicators of Environmental Justice for Scotland." *Environmental Values*, volume 14,

issue 4, Pages 483–501

Toke, D. (2002), “Wind power in UK and Denmark: Can rational choice help explain different outcomes?” *Environmental Politics*, 11 (4), Pages 83-100

Trana, K., N. Sae-Khow, P.M. Nilsen (2019), “Motstandsbevegelsen.” NRK Trøndelag: 20.08.19. URL: https://www.nrk.no/trondelag/xl/vindkraftmotstanden-i-norge-oker-_-noen-aksjonister-gjor-alt-de-kan-for-a-sabotere-utbyggingen-1.14641582

Voigt, C.C., L.S. Lehnert, G. Petersons, F. Adorf, Bach L. (2015), “Wildlife and renewable energy: German politics cross migratory bats.” *Eur. J. Wildl. Res*., 61 (2), Pages 213-219

Wang, S., Wang S. (2015), “Impacts of wind energy on environment: a review.” *Renew. Sust. Energ. Rev*., 49, Pages 437-443

Warren, C.R., M. McFadyen (2010),“Does community ownership affect public attitudes to wind energy? A case study from south-west Scotland.”*Land Use Pol.*, 27 (2) , Pages 204-213

Wind power monthly (2020), “Energy cost analysis 2020: Wind is ready for zero-subsidy future.” Updated: 31/01/20 URL: https://www.windpowermonthly.com/article/1671659/energy-cost-analysis-2020-wind-ready-zero-subsidy-future

Wolsink, M. (2000), “Wind power and the NIMBY-myth: institutional capacity and the limited significance of public support.” *Renew Energy*, 21, Pages 49-64

Wolsink, M. (2006), “Invalid theory impedes our understanding: a critique on the persistence of the language of NIMBY.” T*ransactions of the Institute of British Geographers*, 31, Pages. 85-91

Wolsink, M. (2007), “Wind power implementation: the nature of public attitudes,

equity and fairness instead of backyard motives.” *Renew Sustain Energ Rev*, 11, Pages 1188-1207

Zerrahn, A. (2017), “Wind power and externalities.” *Ecol Econ*, 141, Pages 245-260

Åsnes, A., S. Hole, I. Eriksen, K. Skeie, A. T. Nilsen (2020), “Svein angrar – ville aldri sagt ja i dag.” NRK Møre og Romsdal: 02/07/20, URL: https://www.nrk.no/mr/over-50-prosent-har-snudd-i-synet-pa-vindkraft-_-svein-_54_-angrar-pa-det-valet-han-tok-1.15065933