

Energy Scenarios and Justice for Future Humans: An Application of the Capabilities Approach to the Case of Swedish Energy Politics

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Energy production and consumption give rise to issues of justice for future humans. By analysing a specific case – Swedish energy politics – this article contributes to the discussion of how consideration for future humans should affect energy policy making. It outlines three different energy scenarios for the period 2035-2065 – the nuclear-renewables, the renewables-low and the renewables-high scenarios – and assesses them from the point of view of justice for future individuals by using the capabilities approach as a normative framework. We cannot make a definitive assessment of the different scenarios due to the great uncertainties involved in determining the impacts on individuals living between 2035 and 2065 and individuals born thereafter, but we still conclude that we have certain reasons to prefer the renewables-low scenario since it avoids certain risks connected with the other scenarios. The economic growth in this scenario is lower than in the others, but we question whether this is a disadvantage from the point of view of the capabilities approach.

Keywords: energy scenarios, justice, future generations, capabilities approach

Introduction

Though the use of energy is a pre-supposition for a modern life style, it also gives rise to issues of justice for future humans.¹ All energy sources – nuclear energy, fossil fuels as well as renewables – have some possible negative impacts on the lives of future humans. There are strong moral reasons to consider these impacts, both from the points of view of Utilitarianism and of deontological theories (Thompson 2009, Tremmel 2014).

The first purpose of this article is to contribute to the ethical debate concerning how our duties to future humans should affect energy policy making by focusing on a specific country, Sweden (our home-country). Since the Second World War,

the choice of energy technologies has been one of the most controversial political issues in Sweden. For example, some political parties have argued for the continued use of nuclear power, while others have argued for a quick phase-out (Anshelm 2000). The reason for choosing to study a specific country is that political decisions about energy use are mainly made at the national level today. Therefore, it seems reasonable to analyse the policy options in a particular country. Moreover, it is difficult to draw any general conclusions about which energy scenarios are preferable since feasible energy scenarios are dependent on the political, social and ecological conditions in a country. For example, Sweden has a larger potential for hydroelectric power than many other countries, due to the many large rivers in the north of the country. In addition, the impacts of different energy scenarios are also dependent on the specific social and ecological conditions in a country. We outline three different energy scenarios (for a discussion of the use of scenarios in energy research, see Paltsev 2017) and analyse how they can be assessed from the point of view of justice for future humans. The focus on energy scenarios, rather than on a single energy technology, is motivated by the fact that it is problematic to make an ethical assessment of a single energy technology in isolation. This is because phasing out one specific energy technology will certainly require replacing it with another energy technology that has its own drawbacks as long as we want to maintain a certain level of energy production and consumption (Hillerbrand 2015).

The second purpose of this article is to contribute to the debate on how the capabilities approach can be applied to questions of justice to future humans, especially in the context of energy policy making. This approach is Martha Nussbaum's version of an approach or theory that, in its more general form, can be denoted as the capability approach or capabilities theory (Robeyns 2016, Holland 2014). It has become increasingly influential as an approach to issues of social justice, such as questions concerning gender inequality (Walker, Berekashvili, Lomidze 2014), and recently it has been applied to issues concerning our responsibility towards future individuals (Watene 2013). Consequently, it is of great interest to examine how it can be used in the context of energy policy making. A few attempts have been made to apply the capabilities approach to the issue of energy policy making and justice, for example, by analysing how different capabilities are affected by limited access to energy and the negative environmental impacts of energy production (Day, Gordon, Simcock 2016, Hillerbrand 2015), but more research is needed.

There are, of course, many other normative approaches that can be used for analysing issues of justice to future humans, but we do not have the space here for a more detailed discussion of their possible advantages and disadvantages. For the purpose of this article, it is enough to assume that the capabilities approach is one valuable approach and not necessarily preferable to all others (for a defence of capabilities as a unit for intergenerational distributive justice, see Page 2007A).

It should be noted that the aim of the article is to contribute to the ethical debate on how concern for future humans should affect energy policy making. We do not aim to contribute to the natural scientific, technological or economic debate, although we make use of results from such studies.

We start by briefly describing the capabilities approach and how it can be applied to analysing issues of justice for future individuals. Thereafter, we analyse how the three energy scenarios should be assessed.

The capabilities approach and issues of justice for future humans

Capability is, of course, the key concept within the approach. It is defined in contrast to 'functionings', which refer to what people actually are or do, such as being workers or homemakers, or members of religious organizations. Functionings can be both complex and very elementary. Capability denotes the opportunity to choose a specific functioning. The emphasis on freedom of choice is connected with the fact that personal freedom concerning how one wants to live one's life is regarded as a fundamental value within the capabilities approach. Consequently, the promotion of capabilities, rather than functioning, should be the goal of political decision making. For example, people should have the opportunity to have leisure time, but they should also be allowed to work sixteen hours a day if they so choose (Nussbaum 2013: 24-26, Nussbaum 2000: 87-88).

From the point of view of the capabilities approach, it can be argued that we should also consider the capabilities of future humans. The duties that we have to other individuals are derived from their capabilities, which in turn are derived from their human dignity. In contrast to contractarian theories, such as Rawls's theory of justice, social cooperation within the same society is not a requirement for having duties to others. Nussbaum claims that we have duties to humans in all parts of the world, based on what they need to live a dignified human life. Therefore, the capabilities approach should be applied globally, not just nationally. All the citizens of the world should be assigned the same entitlements, and these form the basis for the correlative duties that others have. All humans have an obligation to promote a dignified life for everyone, not only for fellow nationals (Nussbaum 2006: 273-280). If cooperation is not a requirement for deriving duties to people in other parts of the world, it seems inconsistent to regard it as a requirement when considering whether we have any duty to people living in the future. In accordance with Nussbaum's capabilities approach, we also have reasons to assign to future humans certain entitlements that are necessary for living a dignified human life. The capabilities approach seems consistent with a principle of time neutrality, according to which we should not treat individuals differently just because of their position in time (Ekelin 2004: 429). Moreover, we should consider future humans in all parts of the world, since we cannot justify limiting our concern to current and future humans living in Sweden only.

When applying the capabilities approach to questions of energy justice for future humans, we first need to establish a list of capabilities in order to analyse how current and future humans are affected by the production and consumption of energy. Nussbaum has put forward the following list of capabilities, of which each individual should be guaranteed a threshold level: 1) life, 2) bodily health, 3) bodily integrity (mobility), 4) senses, imagination, and thought, 5) emotions, 6) practical reason, 7) affiliation, 8) other species, 9) play, 10) control over one's environment, both political and material (Nussbaum 2000: 74-81, Nussbaum 2013: 33-34).

This extensive list seems relevant in an intragenerational context when comparing the impacts of a certain policy on different groups or individuals living now. However, when analysing the impacts on future humans, especially those living 50 years or more from now, we should acknowledge that the realization of capabilities by future humans is only partially dependent on the actions of current humans. Whether their capabilities are respected and promoted is to a large extent affected by the political decisions made during their lifetimes. For example, whether individuals born 50 years from now will realize the capability of senses, imagination or thought or not is only partly determined by decisions made by current humans. For example, if we emit a large amount of greenhouse gases so that individuals born in 50 years live in a world with a global mean temperature of 6°C above the current mean, the frequency of drought and floods is likely to increase significantly. As a result, the increased temperature could lead to a notable decrease in human welfare and a weakening of social institutions, such as the educational system. However, the impact on the education of future humans is still only partly a consequence of the actions of current humans and is to a large extent influenced by future decisions.

The actions of current humans will impact the environmental goods of future individuals to a large extent but their personal and social goods to a lesser extent, since these goods are more strongly influenced by future decisions. When analysing the capability deprivations of future humans, it is necessary to distinguish between deprivations caused mainly by current humans and those caused mainly by future humans themselves. It is primarily the former that are of interest in the context of justice to future humans. For that reason, our analysis needs to focus on the capabilities connected with material well-being, as they are more directly related to environmental goods. Moreover, since being able to freely choose one's life is central to Nussbaum's capabilities approach, and since this capability is also greatly influenced by the actions of current humans, we include the capability of practical reason in our analysis. Thus, our list encompasses the following capabilities: 1) life, 2) bodily health, 3) practical reason, and 4) control over one's material environment. The capability to live with other species will also be strongly affected by different energy scenarios. However, we do not include it in our analysis, partly due to space limitations and partly since it is often argued that it is less important than many of the other capabilities (Okin 2003: 311).

We set relatively low thresholds for the different capabilities, which is in line with Nussbaum's intention that the capabilities approach should be understood as a minimal theory of justice (Nussbaum 2000: 75). Concerning the capability of life, we consider the threshold to be a length of life that is considerably lower than the current global average. Regarding bodily health, individuals are considered to be situated below the threshold only if they suffer from serious diseases. As for the capability of practical reasons, individuals are considered to be below it only if they have considerably fewer opportunities to decide how to live their lives than the average individual in today's democratic societies. Concerning the capability of control over one's environment, people are considered to be below it if their property, including land, is in very poor condition.

In line with Nussbaum's argumentation, a minimal requirement of justice is that current individuals should not cause or risk causing future individuals to be situated below the threshold value for any of the listed capabilities. However, since

all energy scenarios risk leading to some significant negative impacts for future individuals, we have to make a choice between different scenarios that all entail a certain risk that individuals will be situated below the threshold at least for some of the capabilities on the list. The principle of sufficiency is central for the capability approach, but it can be interpreted in different ways. A moral radical interpretation of it would give sufficiency lexical priority over other principles. This means that increasing the number of individuals existing above the sufficiency threshold for all capabilities should be given priority over all other justice values, such as equality. For example, a situation A in which five individuals are far above the threshold levels for all capabilities and four individuals are very far below the threshold for all capabilities should be seen as preferable to a situation B in which four individuals are slightly above the threshold for all capabilities and five individuals are slightly below it for only one of the capabilities on the list.

However, as the previous example shows, giving lexical priority to sufficiency seems to have outcomes that clearly conflict with common moral intuitions. A moderate interpretation of the principle of sufficiency that recognizes that equality may also be important seems preferable (Page 2007B:15, Arneson 2006: 28). Our guiding principle is therefore that we should choose the scenario that leads to the largest number of future humans existing above the threshold for all the capabilities on the list. However, if a scenario X leads to a slightly larger number of future humans existing above the threshold for all the capabilities on the list than a scenario Y, at the same time as scenario X leads to much greater inequalities among future humans, then scenario Y should be chosen.

In addition, it seems unreasonable that a very small advantage for future individuals should be bought at the expense of very large burdens for current individuals. Thus, our starting point will be that a scenario C is preferable to a scenario D if C leads to a better outcome for future individuals, unless the difference between the two scenarios for future individuals is very small and D leads to a much better outcome for current individuals.

Applying the capabilities approach to the case of Swedish energy politics

When applying the capabilities approach to our case, we make use of earlier scientific studies of possible future energy scenarios for Sweden (IVA 2014, 2016A, 2016B, Energimyndigheten 2016, IEA 2016 and Gustavsson, Särnholm, Stigson, Zetterberg 2011). We also employ earlier scientific studies on historical and possible future impacts of different energy sources, as well as documents about such impacts from Swedish authorities (see below).

We assume that that the Swedish government is going to decide which energy mix should be allowed and promoted between 2035 and 2065.² Today, the consensus both within climate science and politics is that we need to phase out fossil fuels in order to limit global warming to 2°C (McGlade & Elkins 2015: 187-190). To capture and bury CO₂ is sometimes described as a possible solution for continuing to use fossil fuels and at the same time reducing GHG emissions. However, it is questionable whether technologies for carbon capture and storage are a realistic solution since they are both expensive and energy consuming and would require massive investments in the necessary infrastructure (Heinberg & Fridley 2016: 135-136). A significant use of fossil fuels will have considerable effects

on the climate and will contribute to an increased frequency of drought, floods and cyclones in the future (IPCC 2014: 8). It is highly likely that scenarios including a significant use of fossil fuels will cause a larger number of future humans to be situated below the threshold for any of the capabilities than scenarios with only a limited use of fossil fuels, if the differences between the scenarios are small in other respects. Nuclear energy is another controversial energy technology, which is currently an important part of the Swedish energy mix. However, in contrast to fossil fuels, whether it should be phased out or not is a more contentious issue (Sovacool, Brown, Valentine 2016: 249-270).

Given the arguments above, the following three scenarios seem to be the most preferable in terms of justice to future humans: 1) to phase out fossil fuels and replace them with renewables, and continue with nuclear energy, 2) to phase out both nuclear energy and fossil fuels, and replace them with renewables, or 3) to phase out both nuclear energy and fossil fuels as in the second scenario, but not to replace them with renewables to the same extent. Other scenarios are, of course, possible, but we choose to focus on these scenarios since they reflect two of the main choices Sweden will have to make: to continue with or phase out nuclear energy, and to continue with the current high level of energy consumption or to decrease it substantially. We label the first alternative 'nuclear-renewables', the second 'renewables-high' and the third 'renewables-low'. These scenarios are inspired by the scenarios put forward in a report by the Swedish Energy Agency (Energimyndigheten 2016), but they are more similar to one another in order to facilitate a comparison. Sweden's energy source distribution in 2014 serves as a baseline: fossil fuel 129 TWh, electricity 123 TWh, bioenergy 72 TWh and district heating 51 TWh. The total energy consumption came to 375 TWh (Energimyndigheten 2016).

We assume that Sweden will have a similar social welfare system to today in all three scenarios. The scenarios build on the technologies available today, since it would be problematic to assume the existence and application of new forms of technology during the period 2035-2065.

In the nuclear-renewables scenario, the total energy consumption in the year 2050 is 359 TWh (see the table below). The consumption of nuclear energy will remain relatively high, and wind and solar power will increase in comparison with today.³ The division between the different types of energy in the year 2050 is described below. The economic growth is on average 2% per year,⁴ but the total consumption of energy is lower than in the year 2014 because of higher energy efficiency. The amount of energy used to produce a certain amount of goods and services in 2050 is only 47% of what it was in 2014.⁵

In the renewables-high scenario, both nuclear energy and fossil fuels are phased out by the year 2050. In this scenario, the total energy production and consumption, the economic growth and the energy efficiency are the same as in the nuclear-renewables scenario. The use of nuclear energy in the latter scenario is replaced with an increased use of wind power, solar power and bioenergy.⁶

In the renewables-low scenario, the use of both nuclear energy and fossil fuels is phased out by the year 2050. In this scenario, the use of nuclear energy in the nuclear-renewables scenario is not replaced, which means that the total energy production and consumption is reduced by 60 TWh, to 299 TWh. The renewables-low scenario has less economic growth than the other three scenarios,

approximately 1.5% per year on average, which means that the total levels of transportation and production are a little lower. The energy efficiency is the same as in the other scenarios. In both the renewables-high and renewables-low scenarios, biofuel gas-turbine power is used periodically as a solution to the problem of the intermittency of wind and solar power. Since we need to use biofuel both for producing electricity and for transportation,⁷ it is difficult to achieve a renewable energy scenario with less bioenergy consumption than 100 TWh by the year 2050, unless the amount of transportation decreases drastically.⁸

Energy production and consumption in 2050 divided into different energy types:

Scenarios	Electricity	Bioenergy	District heating	Total energy consumption
Nuclear-renewables	229 TWh	100 TWh	30 TWh	359 TWh
Renewables-high	199 TWh	130 TWh	30 TWh	359 TWh
Renewables-low	169 TWh	100 TWh	30 TWh	299 TWh

Sources of electricity in 2050.

Scenarios	Nuclear power	Hydroelectric power	Wind power	Solar power
Nuclear-renewables	60 TWh	74 TWh	70 TWh	25 TWh
Renewables-high		74 TWh	90 TWh	35 TWh
Renewables-low		74 TWh	70 TWh	25 TWh

When assessing the different scenarios from the point of view of justice for future individuals, we need to predict how each scenario will affect both individuals living between 2035 and 2065 and individuals born after 2065 (hereafter labelled ‘future humans’). Because of the limited space here, we focus on the most significant impacts and differences between the scenarios.

When comparing the nuclear-renewables scenario with the two others, its disadvantages include the risks connected with uranium mining, the disposal of additional nuclear waste and of a core melt-down. The impact of uranium mining leads to low-level, but long-lived, radioactive waste (Smith and others 2012: 295-296). However, so far it has only been established that uranium mining has negative health effects on workers in uranium mines, not on individuals living in the vicinity (Tomasek, Rogel, Tirmache, Mitton, Laurier 2008, Winde, Erasmus, Geipel 2017). Therefore, we cannot draw any conclusion as to whether uranium mining will cause a significant number of individuals living between 2035 and 2065 and a significant number of future humans to be situated below the threshold value for any of the capabilities on the list.

However, the nuclear-renewables scenario seems to pose additional risks, due to the possibility of a core melt-down. If a core melt-down occurs between 2035 and 2065, the risk is high that it will significantly affect several thousand individuals living during that period, as has been the case with earlier core melt-downs, such as Chernobyl.⁹ There is a high risk that some individuals will be situated below the threshold value for one or several of the listed capabilities, primarily those of life and bodily health. In addition, the capabilities of individuals

born after 2065 may be affected if they live in areas contaminated by radiation or are born to irradiated parents.¹⁰ However, a core melt-down is likely to primarily affect individuals living in the 2035-2065 period and only secondarily future humans.

The likelihood of a core-melt down is a contested issue, which is very difficult to predict accurately. According to estimates based on Probabilistic Risk Assessment,¹¹ the risk has been estimated to occur once in every 20 000 to 40 000 reactor years for Generation II reactors (the type of reactors used in Sweden today). If we instead base our estimates on historical data, the core damage frequency becomes considerably higher: according to some estimates as much as once in every 1300 reactor years (Taebi, Roeser, van de Poel 2012: 202-206).

The degree of risk that nuclear waste disposal may lead to is also a controversial issue. In their application for permission to construct a final repository for nuclear waste, SKB (Swedish Nuclear Fuel and Waste Management Company) argues that their proposed method for nuclear waste disposal, KBS-3, fulfils the very strict risk criterion established by SSM (Swedish Radiation Safety Authority), which says that the yearly risk for damage after enclosing the nuclear waste deposit should be at most one per million for a representative individual in the group exposed to the largest risk (SKB 2011: 31-33).¹²

However, other organizations, such as Miljöorganisationernas kärnavfallsgranskning (MKG, the Swedish NGO Office for Nuclear Waste Review), have criticized the assessments made by SKB, since they question the ability of human-made barriers to perform as expected (MKG 2012: 11-12). Some researchers, such as Jantine Schröder, argue that a comprehensive demonstration of the safety of geological disposal is inherently impossible, because the technology is new and involves enormous timescales (Schröder 2016: 689-696).

Given the current scientific debate, we cannot conclude that the risk of a core melt-down and the risk of the spread of disposed nuclear waste are negligible, although they both appear relatively low. Risks also exist in the renewables-high and the renewables-low scenarios connected with nuclear waste disposal, since we need to dispose of the nuclear waste produced before the phase-out of nuclear energy. However, since the amount of nuclear waste is larger in the nuclear-renewables scenario, the risk is higher.

In addition to the risks of a nuclear melt-down and the increased risk of the spread of nuclear waste, a disadvantage of the nuclear-renewables scenario is that it requires considerable resources to decommission nuclear reactors. For that reason, nuclear energy is less reversible than bioenergy and renewables. It will have a negative effect on future individuals' freedom of choice and therefore on their capability of practical reason (Hillerbrand & Peterson 2014: 586). However, given that Sweden will have a similar political system in the near future, individuals living at that point in time will still have the opportunity to exercise their freedom of choice in other areas of life. It is not likely that a significantly larger number of future humans will be situated below the threshold of practical reason in the nuclear-renewables scenario.

The renewables-high scenario has certain disadvantages compared with the nuclear-renewables scenario. The main disadvantage is connected with the higher level of bioenergy production in this scenario. Estimates of greenhouse gas emissions from bioenergy production, regardless of whether it is based on

dedicated biomass or waste treatment, are considerably higher than estimates of greenhouse gas emissions from solar power, wind power and nuclear energy (Kadiyala, Kommalapati, Huque 2016: 8, Amponsah, Troldborg, Kington, Aalders, Hough 2014: 463-469). Due to its effects on global warming, the higher bioenergy production and consumption in the renewables-high scenario risk leading to a higher number of individuals, both those living from 2035-2065 and future humans, being situated below the threshold for any of the capabilities.

Producing more wind and solar power also requires greater amounts of rare earth elements (REE), the mining of which leads to large negative environmental impacts (Paul & Campbell 2011: 14). However, so far it has not been shown that REE mining has considerable negative effects on individuals living close to those mining areas (Zhu and others 2005, Hao and others 2015). In addition, the higher use of REE means that fewer resources will be left for current and future humans, but determining how much they will be affected is difficult. It is thus uncertain whether the higher use of REE in the renewables-high scenario will cause a significant number of individuals living from 2035-2065 or future humans to be situated below the threshold for any of the capabilities.

An additional disadvantage with the renewables-high scenario is that the increase in wind and solar power requires more land use. The low-energy density of these energy sources is often described as problematic (Hillerbrand 2015: 246). However, since Sweden is a sparsely populated country, it is not likely that the land use connected with a moderate expansion of wind and solar power will cause a significant number of people living in the 2035-2065 period or future humans to be situated below the threshold for any of the capabilities.

As seen above, uncertainties connected with determining the likely consequences for future humans of the two scenarios abound, making it difficult to conclude which of these is preferable. We cannot say whether the higher wind, solar and bioenergy power production and consumption in the renewables-high scenario are likely to cause more individuals living from 2035-2065 or future humans to be situated below the threshold for any of the capabilities than the nuclear energy production in the nuclear-renewables scenario. Moreover, we do not have any reason to expect that one of the scenarios will lead to considerably larger inequalities among future humans than the other. To conclude, we do not have any strong reason to prefer one of the scenarios from the perspective of justice to future humans.

The renewables-low scenario does have certain advantages compared with both the other scenarios. In contrast to the nuclear-renewables scenario, the renewables-low scenario avoids the risks connected with a core melt-down and the disposal of additional nuclear waste. In comparison with the renewables-high scenario, it avoids the impacts of additional use of bioenergy and additional production of wind and solar power, although the latter can be expected to have fewer negative consequences.

A potential disadvantage in the renewables-low scenario is the lower production of goods and services, but it can be questioned whether this is really a disadvantage from the capabilities approach point of view. According to what has traditionally been the dominant view within economics, higher economic growth leads to increased welfare for both current and future humans. Current individuals will be able to consume more goods and services and future humans will also benefit, since

a higher level of economic growth leaves more human-made capital to future humans, as well as more advanced technologies to manage environmental problems. However, the capabilities approach questions the traditional view of social development within economics. For example, Nussbaum argues that GNP per capita is misleading as a measurement for social development since it ignores questions about the distribution of wealth and income. Moreover, important goods, such as life expectancy, are not always well correlated with wealth and income (Nussbaum 2000:60-61). Since the capabilities approach is primarily concerned with helping individuals reach the threshold level, increased economic growth is of limited value unless it improves the situation for individuals situated below the threshold. In addition, many of today's economists are sceptical of whether increased economic growth necessarily benefits current and future humans, partly due to increasing recognition of the negative environmental effects of higher production and consumption. Some claim that it would be preferable for humanity as a whole if developed countries slowed down their rate of growth, or even decreased their production of goods and services (Abramovay 2016, Daly 2014, Kallis, Demaria, D'Alisa 2015).

In this particular case, it seems uncertain whether the lower economic growth in the renewables-low scenario would cause a higher or lower number of future humans to be situated below the threshold for any of the capabilities. It is likely that in the renewables-low scenario, we will have less human-made capital and fewer advanced technologies after 2065, but the overall consequences for future humans are not necessarily negative since lower production and consumption during the period 2035-2065 would also mean less depletion of natural resources. On a global level, it may very well be the case that a smaller number of future humans will be under the threshold for any of the capabilities, due to the lower economic growth in Sweden during this period.

The lower economic growth in the renewables-low scenario could be a disadvantage if it is likely to lead to a considerably higher number of individuals living between 2035-2065 being situated below the threshold, even if the likelihood of a higher number of future humans being situated below the threshold is unclear. However, we do not have strong reasons to expect that this scenario would have such consequences. As for Swedish citizens, the fact that Sweden already is an affluent country with a strong welfare system means that lower economic growth does not necessarily lead to a larger number of individuals ending up below the threshold level for any of the capabilities. The social welfare system would provide for many of the individuals with limited means so that they would still reach the minimum threshold level. As for individuals living in other parts of the world, the consequences are considerably less certain. Lower consumption in Sweden may mean lower incomes for citizens in other countries, but how much lower and how much they will be affected is unclear. At the same time, the lower production and consumption of resources in Sweden may lead to fewer negative environmental effects for individuals in other parts of the world.

To conclude, the case study clearly shows the difficulties involved in making an assessment of different scenarios from the point of view of justice to future humans. Due to the great uncertainties about the possible impacts on humans living between 2035 and 2065 and on future humans, we cannot make a definitive assessment of the three scenarios based on justice to future humans. However, we

still have certain reasons to prefer the renewables-low scenario. It avoids the risks connected with nuclear energy production in the nuclear-renewables scenarios and the higher production of bioenergy, wind and solar power in the renewables-high scenario. At the same time, it is uncertain whether the lower production and consumption of goods and services in this scenario would lead to a larger or smaller number of individuals being below the threshold for any of the capabilities in either of the timeframes considered. In addition, we do not have any reason to expect that the renewables-low scenario will lead to significantly larger inequalities between future humans than the other scenarios.

Conclusion

In this article, we discuss how the capabilities approach can be applied to issues of justice to future humans, especially in the context of energy policy making. We conclude that within the framework of the approach, we have reason to assign capabilities to future humans based on their human dignity. Because future humans' realization of some capabilities on Nussbaum's list will primarily be a consequence of decisions made after they have been born rather than of the actions of current humans, we suggest a shorter version of the capabilities list for analysing issues of justice to future humans: 1) life, 2) bodily health, 3) practical reason and 4) control over one's environment.

We apply the capabilities approach to three different scenarios for Swedish energy politics for the period 2035-2065: the nuclear-renewables, the renewables-high and the renewables-low scenarios. We cannot reach a definitive conclusion because of the uncertainties connected with predicting the consequences of the scenarios, but we still have certain reasons to prefer the renewables-low scenario. This scenario, in comparison with the nuclear-renewables scenario, avoids the risks of nuclear energy production and of managing additional nuclear waste during the period 2035-2065. Compared with the renewables-high scenario, the renewables-low scenario avoids the risks of additional bioenergy use and increased production of wind and solar power. The economic growth is lower in the renewables-low scenario, but it is uncertain whether that would lead to a higher or lower number of current and future humans being situated below the threshold for any of the capabilities. From the point of view of the capabilities approach, we need to question whether higher energy production with concomitant higher economic growth in a developed country is always preferable. However, we would have stronger reasons to prefer a scenario with higher energy production in a developing country, in which a large number of today's individuals find themselves below the threshold for one or several of the capabilities on our list.

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Notes

¹ We use the term 'future humans' rather than 'future generations' since it is problematic to claim that we have duties to generations as collective entities over and above the duties we have to the individuals constituting the generations. Such a claim presupposes that generations can have morally relevant interests that differ from the interests of the individuals constituting the generations. Moreover, the focus on individuals is also in line with Nussbaum's capabilities approach since she argues that capabilities should primarily be ascribed to individuals, not groups (see Nussbaum 2013: 35).

² What can be considered feasible after that period of time is difficult to predict because of possible future innovations in the area of energy technology. Moreover, a more sudden change of the current energy mix, for example by phasing-out nuclear energy by the year 2025, will be very expensive and will make it necessary to import electricity produced by fossil fuel plants (see IVA 2016:14 and Qvist & Brook 2015: 1-10). How energy is produced is, of course, also determined by market decisions and not only by political decisions; but political decisions still determine the framework within which market decisions are made.

³ An expansion of wind power is economically realistic since it has become relatively cheap and is expected to become even cheaper in the future, see (Nohlgren, Herstad Svård, Jansson, Rodin 2014). The cost of solar power is also decreasing, see (MIT 2015).

⁴ This is the same average economic growth as Sweden has had since the 1970s (the webpage of Statistics Sweden, accessed 2019-01-03).

⁵ According to estimates by the Royal Swedish Academy of Engineering Sciences (IVA), significantly increased energy efficiency in Sweden is both technologically and economically feasible (IVA 2014). It is also in line with the dominant political goals. In November 2016, the government made an agreement together with the New Moderates, the Centre Party and the Christian Democrats that Sweden will have 50% more efficient energy use in 2030, compared to 2005 (the webpage of the Swedish government, <http://www.regeringen.se>, accessed 2017-08-03).

⁶ Such an increase of wind and solar energy seems realistic, although it requires investments in technology for storing energy. According to estimates by the Royal Swedish Academy of Engineering Sciences, in Sweden land-based wind energy has a potential of 160 TWh and solar energy a potential of 50 TWh (IVA 2016A, IVA 2016B). According to several prognoses, a long-term phase-out of Swedish nuclear energy is technically and economically feasible. For example, a study from the International Energy Agency states that nuclear energy in Sweden can be completely phased-out before 2040, International Energy Agency (2016): *Nordic Energy Technology Perspectives 2016: Cities, flexibility and pathways to carbon-neutrality*, Paris.

⁷ A total replacement of fossil fuels with electricity within the transport sector does not seem likely in the near future (Heinberg & Fridley: 81-94, Gustavsson and others 2011: 33).

⁸ In the study by the Swedish Energy Agency, the bioenergy consumption is 100 TWh in the scenario with the lowest bioenergy consumption (Energimyndigheten 2016). Moreover, in another study of the future Swedish bioenergy consumption,

it is estimated to be between 165-248 TWh in 2050 (Gode, Särnholm, Zetterberg, Arnell, Zetterberg 2010:55).

⁹ A WHO report, based on earlier scientific studies, estimates the number of premature deaths due to the Chernobyl accident to be in the magnitude of several thousand. According to the report, there is no doubt that it has led to significantly higher rates of thyroid cancer among the population in the most heavily contaminated areas. However, there is no convincing evidence that it has led to increased risk of other cancer forms, such as leukaemia (Bennet, Repacholi, Zhanat 2006:2, 53, 60 and 64).

¹⁰ There is a high risk that a major core melt-down will also affect future individuals. As for Chernobyl, children born after the accident in the areas contaminated by radiation, or children born in non-contaminated areas but by irradiated parents, had an increased frequency of genome damage, which is associated with higher risk of cancer, see (Fucic, Aghajanyan, Druzhinin, Minina, Neronova 2016).

¹¹ Probabilistic Risk Assessment consisting in identifying the event that could lead to an accident and assigning probabilities to them.

¹² It should be pointed out that the application was rejected by the Land and Environmental Court, which considered some issues regarding the security of the KBS-3 method not to have been sufficiently examined, mainly connected with whether the copper capsules in which the nuclear waste should be deposited would be sufficiently resistant to corrosion, see Mark- och miljödomstolen 2018.

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