Chapter 5
Energy Justice Assumptions of Energy Storage Experts

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Abstract: Normative assumptions often remain implicit and undebated in technology development. This is unsurprising because many normative ideas seem universal yet are actually particular standards of dominant social groups. As norms pose as universal, they deny legitimacy to alternatives, ignore moral plurality and eliminate the potential for a more just society. Energy technologies, in particular, have been decoupled from ethical reflection for a long time. Although energy justice scholarship aims to fill this gap, its researchers generally focus on the (un)just effects of already developed energy systems. This chapter illustrates how energy justice can be leveraged in the innovation phase to identify implicit and seemingly universal normative assumptions, unlocking a deeply critical potential beyond merely evaluating the consequences of energy technologies. Four workshops were held with energy storage experts to study their energy justice assumptions, whether they acknowledge moral plurality, and how they deal with normative uncertainty. The results show that experts have – and can articulate – specific conceptions of justice about the scale, time, subjects, and principles of justice in relation to energy storage technologies, such as liberal nationalism, anthropocentrism, and utilitarianism. Yet, other defensible normative assumptions circulate in philosophical debates. Some, but not all, normative uncertainties were acknowledged by the participants. When they were, they resolved normative uncertainties by resorting to utilitarian reasonings, dismissing moral questions as subjective, and relying on existing institutional frameworks. The findings stress the importance of a public debate on energy justice, fostering value change in the long run.

Keywords: Energy Justice; Energy Storage; Energy Transition; Normative Uncertainty; Value Change.

Introduction

Technologies embody moral values, and as such, they are not neutral (Klenk, 2021; Sovacool et al., 2016; Sovacool & Dworkin, 2014; Winner, 2017). Technologies and their properties are shaped by people – engineers, designers – who have normative assumptions, such as values, visions, and ideas about justice and the good life. Although intentions and normative ideas do not fully determine the use or the (un)just consequences of technologies (Klenk, 2021), they steer innovation and development, and as such, they can engender (in)justice (Karwat, 2019). Normative assumptions play a pivotal role in design decisions, in acquiring funding that prioritises the development of some technologies over others, and in influencing the public debate and the political and scientific agenda (Dignum, 2013; Jacobs & Huldtgren, 2021). Therefore, reflecting on the normative assumptions behind and embedded in technologies is crucial.

Still, normative assumptions often remain implicit and undebated in technology development (Pesch, 2021). This is unsurprising because many normative ideas, such as democracy, freedom, growth, nationalism, and liberalism, seem universally shared and uncontroversial. However, following Iris Marion Young, seemingly universal ideas can often be deconstructed as particular and even Western, as they are the standards of the dominant social groups (Young, 1990). As such ideas pose as universal, they deny legitimacy to alternatives, thus establishing a hegemony, an ideology, or a one-dimensional society (Marcuse, 1964). In doing so, normative

uncertainties, which are "situations where there are different partially morally defensible – but incompatible – options or courses of action, or ones in which there is no fully morally defensible option" (Taebi et al., 2020), are denied, and with it the potential for a more just society. Philosophers have a crucial task in identifying the normative assumptions taken for granted, deconstructing them as particular, and questioning them.

Energy technologies, in particular, have been decoupled from ethical reflection for a long time, even though energy innovations and cultural and societal developments are deeply interwoven (Shove & Walker, 2014). As a case in point, it was not until 2013 that researchers stressed the importance of systematically reflecting on justice in relation to energy systems (McCauley, 2013). Energy justice frameworks are often considered conceptual, analytical, and decision-making tools to make energy systems more just (Sovacool & Dworkin, 2015; Jenkins et al., 2016). Nevertheless, Sovacool et al. (2021) and Jenkins et al. (2020) separate energy justice from value-sensitive design and responsible research and innovation, arguing that energy justice evaluates the impacts and effects of already developed technologies. Consequently, energy justice research generally focuses on the (un)just effects of energy systems instead of the normative assumptions and values that steer their development.

This chapter explores how energy justice can be leveraged in the innovation phase to identify implicit and seemingly universal normative assumptions, unlocking a deeply critical potential beyond merely evaluating the consequences of energy technologies in terms of justice. To do so, it studies the energy justice assumptions of energy storage experts. Energy storage is chosen as a case because it will be crucial for future renewable energy systems, yet further innovation is required, and because of technological complexities, this generally occurs without philosophical reflection. Four workshops were held with experts on hydrogen production and redox flow batteries from the Netherlands and the United Kingdom to identify their energy justice assumptions. In sum, this chapter studies (a) the energy justice assumptions of energy storage experts, (b) whether these experts acknowledge moral plurality, i.e., the particularity of their own assumptions, and (c) how they deal with or resolve normative uncertainty.

Section 4.2 introduces the energy storage technologies discussed in the workshops, and it explains the workshop design and analysis. Section 4.3 describes the results, in other words, the dominant energy justice assumptions held by the workshop participants. Section 4.4 contrasts these results with other possible justice assumptions, highlighting the normative uncertainties and the ethical questions they trigger. Section 4.5 explores how participants resolve normative uncertainties. Section 4.6 concludes.

1. Workshops with Energy Storage Experts

1.1 Energy storage: green hydrogen production and redox flow batteries

Realising the energy transition requires a large-scale shift to renewable energy. When most renewable energy sources are intermittent, large-scale energy storage will be vital for a stable and secure net-zero energy system (Gallo et al., 2016; Ver-

zijlbergh et al., 2017). Energy storage solutions that are likely to play an essential role in our energy future are green hydrogen production and redox flow batteries.

Green hydrogen production is crucial for decarbonising industry, long-haul transportation, and seasonal energy storage (Gupta, 2009; Sovacool et al., 2024). Green hydrogen can be produced through electrolysis powered by renewable energy sources. Nevertheless, large-scale implementation faces challenges, including intermittent renewable energy sources, high costs (due to the necessity of precious metals, high electricity prices, and inefficiency due to the technology's relative immaturity), and limited options for storing hydrogen (McDonnell-Worth & MacFarlane, 2018; Griffiths, 2024).

Redox flow batteries are a potential solution to the problems intermittent green electricity poses for stabilising the electricity grid, as they can store energy for a relatively long time, from two to twenty hours, without using expensive, scarce materials (Hugo et al., 2018). Redox flow batteries are a type of electrochemical energy storage, as they store and release energy through reversible chemical reactions. In theory, there are infinite options in terms of chemistries that can be used. Currently, the most advanced type is the vanadium redox flow battery. However, as vanadium is relatively expensive (Schmidt et al., 2019), researchers are exploring alternative chemistries.

1.2 Workshop Design: Measuring Energy Justice Assumptions

To study the energy justice assumptions of energy storage experts, three workshops on hydrogen production and one on redox flow batteries were held in November 2023. In each workshop, there were 3-6 participants, who were all senior and influential experts and innovators with a technological background and a birds-eye view of the potential consequences of the technologies under scrutiny. Because the population of such experts is rather small, their job titles and names are not included in this chapter.

Although there are many different types of workshop designs in energy social science research, such as co-creation, backcasting and futuring workshops, a workshop for identifying and discussing normative assumptions seems lacking, justifying a more explorative approach. The workshop was designed to identify energy justice assumptions, using the revisited energy justice framework by Van Uffelen et al. (2024) as a theoretical framework, as it defines categories of assumptions on which there is normative uncertainty (see Figure 1). The framework discerns four *tenets of justice*, namely distributive justice (the just distribution of goods, burdens and benefits), procedural justice (just decision-making procedures), recognition justice (on just relations of recognition, which excludes institutionalised cultural injustices such as devaluing, ignoring, and marginalising social groups), and restorative justice (the just restoration of injustices). Moreover, the framework classifies *justice assumptions*, including the subject (e.g., justice for humans or multispecies justice), scale (e.g., justice in a local, regional, national, continental, or global context), timeframe (e.g., justice for the current or also future generations), and principles of justice (e.g., rules or yardsticks that define under what conditions something is just or unjust).[1]

[1] The fifth category, knowledge, was not part of the workshop design, as this study focuses on normative assumptions, not on epistemic assumptions. However, some

These categories of assumptions mirror deeply contested philosophical debates on justice (Miller, 2017).

	Principles of justice			
Distributive justice	Knowledge	Subject	Time	Scale
Procedural justice				
Justice as recognition				
Restorative justice				

Figure 1 – The energy justice framework (Van Uffelen et al., 2024).

The workshop's design was informed by two scoping interviews with academic experts on hydrogen production and redox flow batteries and a mock workshop with academic colleagues. For practical reasons, the two-hour workshops were held online via Zoom, using the software Miro for the collaborative exercises. The transcripts were pseudonymised and analysed in Atlas.ti.

In the workshops, participants were first asked to write on virtual Post-its what good or bad consequences the technology might have and put them on a matrix (the x-axis being good/bad; the y-axis likely/unlikely). Then, they were asked to pick four consequences– two good, two bad – to dive into during the rest of the workshop. The moderator asked for each post-it *why* this is a good or bad consequence, in other words, what makes it good or bad. This stimulated the participants to make explicit their normative orientations. Often, further why-questions were required to make these explicit (for example: why is climate change bad?). To dive further into the normative assumptions, participants were asked to articulate for 'who/what' this was a good or bad consequence (which measured both the subject and the scale of justice) and 'when' this would be good or bad (targeting the time component). In the last 20-30 minutes of the workshop, a stakeholder map was revealed that showed the following stakeholders: ecosystems and animals; people in the Global South; privileged people in the Global North; local people in the Global North; technology innovators and companies; marginalised groups in societies; and future generations. The participants were asked to reflect on what stakeholders they had not yet explicitly mentioned during the workshop, why, and what it would mean to take these stakeholders into account. Moreover, they were asked whether each stakeholder was equally important. This critical reflection exercise encouraged participants to articulate further or question their views on energy justice and challenged participants to imagine alternative conceptions of justice.

The normative assumptions of the participants were analysed through Van Uffelen's energy justice framework. Moreover, attention was paid to whether participants acknowledged alternative conceptions of justice and, if they did so, how they dealt with and resolved normative uncertainty.

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epistemic uncertainties were articulated in the workshops, and as such they were part of the analysis.

Due to the small sample size, the conclusions only pertain to the normative assumptions of these experts, and generalisations are not warranted. However, the implicit normative assumptions taken for granted by the participants shed light on conceptions of justice that are seemingly universalised, and how participants deal with normative uncertainty may reflect tendencies in the larger population. As such, this empirical philosophy study provides claims made by critical theorists with empirical grounds and informs philosophical reflections on energy justice.

2. Dominant Conceptions of Energy Justice

2.1 The Distributive Paradigm

In the first part of the workshop, participants were asked to articulate possible 'good' and 'bad' consequences of the energy storage technology at hand and then choose four to elaborate on for the remainder of the workshop. From their interpretations of the chosen post-its (for an overview, see Table 1), it can be derived that most consequences relate to distributive (in)justice. This implies that 'good and bad consequences' were mostly interpreted as an unjust distribution of goods, burdens and benefits. There were only a few exceptions to this.

First, procedural justice – which is a concern for just decision-making procedures – came up in relation to two Post-Its. On the one hand, participants in the second, third, and fourth workshops chose to focus on energy autonomy, independence, or energy security. In all three discussions, autonomy, control, and freedom were central tenets. These relate to procedural justice, as it was generally deemed undesirable that decisions were influenced by foreign and potentially malign states.

"[energy security] *makes like a country or a, uh, or a region or whatever less prone to well all kinds of manipulation or blackmail or that kind of thing in a political sense*" (workshop three)

On the other hand, the consequence of 'safety incidents and image' was often associated with a lack of public acceptance, which can be read as a procedural justice concern. Nevertheless, public acceptance seemed to be mainly of instrumental importance to the participants because it delays decarbonisation, the energy transition, and the uptake of hydrogen technologies.

Second, restorative justice came up once in workshop four. One participant repeatedly stressed the unequal historical contributions to climate change and the implications for responsibilities towards the Global South. This implies that there is an injustice that ought to be restored.

Third, reflections on recognition justice – which are concerns for institutionalised cultural injustices, such as marginalisation and devaluation (van Uffelen, 2022) – were scarce. In some instances, participants acknowledged that the energy transition has a disproportional impact on people in poverty (workshop one and three) or communities that rely on fossil industries (workshop two). However, without a link to institutionalised cultural injustices, concerns for marginalised actors can be interpreted as distributive justice concerns. To argue that these concerns are instances of misrecognition, some hidden premises would have to be assumed.

Workshop	Chosen post-its	Evaluation
1 - Green hydrogen production	Decarbonisation of hard-to-abate industries/decarbonization, right production, little leakage	Good
	Synergy effects from small to large scale (water, heat, biomass, system integration)	Good
	For health, safety & environment, we need to go through a learning curve	Bad
	(New) infrastructure takes time and is expensive	Bad
2 - Green hydrogen production	Political/geographical independence energy supply	Good
	Decarbonisation	Good
	Hydrogen-related safety incidents; safety & image - one huge incident may reduce the current popularity abruptly	Bad
	Loss of jobs	Bad
3 - Green hydrogen production	Preserve industrial activities	Good
	Improved energy security	Good
	Higher energy costs	Bad
	Perceived risks & safety issues with explosive gas	Bad
4 - Redox flow batteries	Decarbonization of the energy system	Good
	Energy autonomy	Good
	Increasing costs for citizens	Bad
	Lack of regulations	Bad

Table 1 - An overview of the Post-Its formulated by the participants that were chosen as the focus for the workshops and whether they perceived the Post-it as a 'good' or a 'bad' consequence of the technology.

2.2 The Scale of Justice

Participants were asked to elaborate on 'for whom' the (un)just consequences were unjust. From their answers, the assumed scale of justice can be deduced as each consequence was considered good or bad for a local community, a (supra)national entity, and/or everyone globally. The data shows that participants assume different scales when discussing different topics. Moreover, there were significant tensions between global, local, and (supra)national scales of justice that were sometimes, but not always, made explicit by participants.

Some participants in workshops one and two explicitly dismissed local justice because local claims slow decarbonisation and are thus to be ignored. However, when discussing risks and safety issues, synergy effects and the loss of jobs, participants stressed local justice. For example, in workshop two, participants stressed that energy infrastructures 'in our backyard' should also benefit communities.

"People don't want to have, let's say, the mining done in their backyard. Whereas we might sit on huge resources that might be very valuable for energy transition.

How do you deal with that? And how can you make it indeed also... Valuable for the people who live there? Because that is the main..." (workshop two)

A more frequently adopted scale of justice was that of national or supranational (EU) justice. Participants in the second and third workshops were mostly focused on justice for (countries within) Europe. In the third workshop, 'higher energy costs' were a concern for just transitions within countries, and participants discussed whether 'preserving industrial activities' was desirable or not for the Netherlands or the UK. Moreover, in workshops two, three and four, the independence of energy supply was mainly considered good for (countries within) Europe.

However, in all workshops, decarbonisation was discussed in terms of global justice, as it would benefit people globally. In the fourth workshop, both 'increasing costs' and the 'lack of regulations' were generally considered good or bad globally, as they slow down energy transitions. In workshop two, global justice also emerged in the context of energy independence through the notions of 'energy colonialism' and 'fair trade'.

Moreover, in the reflection exercises at the end of the workshops, some participants questioned the assumed (supra)national scale of justice when confronted with the Global South as a stakeholder. Such reflections indicate a global scale of justice. For example, participants started to doubt whether energy autonomy is unequivocally good because, so far, they have only considered this as 'good for Europe'. In workshop three, participants reflected on 'high energy costs' and 'energy security' from the perspective of the Global South.

"I think we have a lot of activities in the Global South where the profit lands in the Global North. And so the people in the Global South may have some jobs from it, but well, they're not really very generously paid and we try to get as much to, well, to our own countries. Yeah. And that's what I would call the wrong way." (workshop three)

Although participants in workshop four started by considering energy autonomy as good for a restricted scale of justice, they gradually started to stress global justice and imply a more elaborate set of responsibilities towards the Global South. They started to explore whether geographical differences between countries are fair or not and what obligations the global north has to the Global South due to the unequal contributions in causing climate change.

"There also has to be a fairness among countries. And this is clearly not there. It is not only that they lack the cash to fund the investment themselves. It's also that they hardly contributed to the mess we're in." (workshop four)

However, there was also push-back against a global scale of justice. For example, participants in workshop three argued that we have only limited responsibility towards the Global South.

"You know, we're not doing this [the energy transition] for the benefit it has to the Global South. But I think the mapping out that transition pathway, that's a lot of value, you know, across the world." (workshop three)

2.3 Subject: Justice for Humans, or Multispecies Justice?

When discussing the consequences, participants articulated 'for whom' these were good or bad. This not only pertains to the scale of justice, but also to the subject of justice. Justice is either *anthropocentric justice* – only for humans – or *multispecies justice*, including animals and/or ecosystems as subjects of justice.

Generally, the participants of all four workshops considered only humans as subjects of justice. This can be drawn from their responses to questions about why decarbonisation is good and from the fact that the impact on animals and the environment was only sporadically mentioned in the first parts of the workshops.[2]

"*If we don't do decarbonization, it basically means it goes at the expense of humans, right? So, it's a human perspective on things, yeah? It's human suffering. It's the destruction of human infrastructure and so on, yeah? Yeah. Or a way of living that humans do."* (workshop one)

In the second part of the workshops, the participants were confronted with 'animals and ecosystems' as stakeholders. Most participants acknowledged that they have not explicitly discussed 'good or bad' for non-humans.[3] During the reflection exercise, participants from all workshops started to explore animals and ecosystems as subjects of justice. For example, workshop two mentioned the impact of energy infrastructure on birds and sea animals and the possibility (and the legal necessity in permit procedures in the Netherlands) of including this in a design (workshop two). Moreover, workshop two mentioned the possibility of animals going extinct due to climate change.

"*We have to be a little bit careful that we don't destroy the world to save the world.*" (workshop two)

Participants were also asked to reflect on the relative importance of 'animals and ecosystems' as stakeholders. From this discussion, it can be drawn that the overall focus is anthropocentric, and nature is considered of instrumental value to humans.

"I think that, when it comes down to it, we have to make choices, and animals and ecosystems will be less important, if I am being really honest about this." (workshop one)

2.4 Principles of Justice

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[2] There is one exception. In the individual exercise in the first workshop, one participant stressed that decarbonisation is good because it avoids harm to the environment. During that workshop, that participant reminded the others twice of the impact of climate change on non-humans.

[3] Workshop two forms an exception; participants claimed they had talked about ecosystems, even though their discussions on decarbonisation have been from an anthropocentric perspective.

Participants were asked to articulate individually and in plenary why each consequence was considered good or bad. As a result, they formulated values and principles of justice to justify the goodness or badness of the chosen Post-its.

One notable finding was that the goodness or badness of all chosen consequences was determined by whether they contribute to or slow down decarbonisation, except for the consequences related to energy autonomy. In other words, decarbonisation and energy autonomy were perceived as two good consequences that are relatively separate from each other.

Decarbonisation is part of the justification of the goodness or badness of all other chosen Post-Its (except energy autonomy), and therefore, the reasons for the goodness of decarbonisation are vital in understanding the normative assumptions of the participants. In the first, third and fourth workshops, decarbonisation and mitigating climate change were considered good because they reduced costs. The utilitarian principles of cost reduction and economic profit reason that something is good 'because it costs less'. This principle returned in almost all discussions on the chosen Post-its.

"*Well, I think if we have no energy transition and we have a lot of climate change, we have a lot of problems, which are a lot worse even than losing your job, I guess, in the longer term. Like, well, food problems, weather problems, big storms, big flooding, droughts, and other things which will, in the end, cost a lot of money* (workshop three).

In the first, second, and fourth workshops, participants measure the goodness of decarbonisation against the principle of maintaining our current living standards. 'Our' Western standard of living was perceived by participants as 'developed', desirable and exemplary for the rest of the world. This interpretation of a sufficiency principle was often framed as the ultimate justification for why decarbonisation and energy autonomy are good and why other Post-its, such as increased energy costs, are bad. Decarbonisation is also good for health, avoiding mass migration, and creating new jobs.

Next, energy autonomy, independence, and security were signalled as good possible consequences of both hydrogen production and redox flow batteries. Although there was much debate on whether energy autonomy would actually be desirable or feasible, several principles of justice shaped the debates. Returning principles were those of costs (if it costs less, it is good) and maintaining our current living standard. Moreover, participants considered negative freedom and control over 'our' destiny as important principles. These intuitions can be understood as principles of national self-determination.

"*There's the ideal situation where, as a nation, that, you know, you have complete control of your energy supply, which is kind of really important.*" (workshop two)

However, participants acknowledged that dependence might not always be undesirable. In this context, participants in workshop four condemned energy colonialism and raised several fair trade principles. For example, a participant argued that international trade should be "*a two-way traffic*". Another participant argued that international trade relations should consider causal responsibility for historical damage. Another argued that fair trade is defined by the principle of desert.

"*Now you mentioned fairness, yeah okay what is fair? If I work hard I deserve more money. Um so it's uh privileged people in the global north*." (workshop four)

2.5 Time: What about Future Generations?

Participants were asked 'when' each consequence would be good or bad, in other words, what timeframe they had in mind.[4] Generally, participants seemed to draw the line between the short and the long term around 20 years from now, which can be rounded up to 2050. As such, in most workshops, the concept of 'future generations' did not come up spontaneously. An exception is workshop four, as participants explicitly argued that the interests of future generations should take precedence over current monetary concerns. However, when participants were confronted with 'future generations' as stakeholders during the reflection exercise, they stressed their importance.

Each workshop displayed a tension between the short and the long term.[5] All Post-its from the 'bad consequences' category, plus the 'decarbonisation' and 'energy autonomy' Post-its, were only considered bad in the short term. Moreover, one Post-it ('hydrogen production preserves industrial activities') was considered good in the short term, while its desirability in the long term was questioned. However, the bad consequences were considered sacrifices that needed to be made for the future. To summarise, in general, post-2050 interests were given priority over pre-2050 interests.

"*Energy transition is a huge upfront investment, just like previous generations who are making a sewer system or drinking water or the electric grid. To get it started, you need to put a lot of money on the table. And then once it's there, okay, you will expand and maintain it. But for future generations, it's very nice that they already inherited it*." (workshop four)

3. Normative Uncertainties

Experts on hydrogen production and redox flow batteries make specific normative assumptions about justice. However, there were contradictions between several assumptions held by the participants. Moreover, there may be morally defensible alternatives. In other words, energy justice is shrouded in normative uncertainties in relation to the timeframe, subject, scale, principles, and tenets of justice.

Normative uncertainty about the subject of justice was hardly acknowledged by the participants. Most participants considered only humans as relevant subjects of justice. Nature and animals were generally seen as instrumental for humans, and this intuition guides decisions on trade-offs between human and non-human interests.

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[4] At first, this resulted in an epistemic discussion about when a certain technology would be developed and implemented. Yet, for most consequences, the assumed timeframe could be deducted.

[5] There was one exception: 'synergy effects' was the only consequence that was considered good both 'now' and in the (far) future (workshop 1).

This *anthropocentric* conception of justice contrasts with assumptions based on *multispecies justice* as defended by some environmental ethics scholars (Celermajer et al., 2021; Tschakert et al., 2021).

There are also vivid philosophical debates on the weight that should be assigned to the interests of future generations. However, normative uncertainty about the assumed temporal modus was largely dismissed in the workshops. Participants acknowledged that certain timeframes sometimes clash, as some consequences were conceived as bad in the short term and good in the long term or vice versa. However, negative consequences in the near future – such as high energy prices and safety issues – did not make participants adopt a negative stance towards the technology. Instead, they were tolerated because they were only temporary, and the technology would contribute to a better world in the long term. In other words, techno-optimism and prioritising post-2050 over pre-2050 interests made normative uncertainty about the adopted timeframe a non-issue.

"*I think the costs will be higher in the short term. In the future, when there is an abundance of renewable energy sources with low marginal cost, the overall cost might decrease for the citizens.*" (workshop four)

Participants adopted a variety of scales of justice, including local, national, supranational, and global perspectives. In theory, however, different scales of justice can clash. For example, justice within the Netherlands or Europe can give rise to global injustices, while global justice can require sacrifices from nation-states. As such, there is normative uncertainty about whether it can be morally justified to restrict justice concerns to a smaller – local or (supra)national – scale or whether there is a moral obligation to include other countries and continents in our moral circle. In most workshops, normative uncertainty about scale became visible when participants reflected on the Global South as a stakeholder. In this context, notions such as "fair trade", "energy colonialism", "historical responsibility", and "unfair advantage" came up. In these discussions, most – but not all – participants seem to adhere to a form of liberal nationalism, which states that citizens have special relations, and thus special obligations of justice, towards each other that they do not have towards non-citizens (Miller, 1995; Tamir, 1993). Global justice is restricted to fair trade relations and duties of assistance when societies fall below a certain humanitarian threshold (Van Parijs, 2007). People in other countries may benefit from hydrogen production and redox flow batteries, but justice for 'them' is not 'our' primary concern. Only two remarks revealed a more far-reaching commitment to global justice, namely that the Netherlands would have an 'unfair resource advantage' (which was quickly withdrawn by the participant by saying it was not unfair, but "*competitive*") and that the Global North has a "*historical responsibility*"' towards the Global South, both in workshop four.

Participants articulated many different principles of justice. Following Michael Walzer, it is not necessarily problematic to adopt different principles of justice for different situations (Walzer, 1983). For example, although strict equality might be a good principle for distributing love to your children, it seems inappropriate when distributing energy to households because different people have different needs. However, when discussing a good or bad consequence, participants often invoke multiple principles, some of which are contradictory. For example, when discussing energy autonomy, the principles of cost reduction, national self-determination, fair

trade as a two-way street, desert, causal responsibility, and sufficiency can clash. These clashes are very much intertwined with the assumed scales of justice. For example, national self-determination might not be the cheapest option, and as such, it may threaten our current living standards. Moreover, cost reduction for 'us' can compete with fair trade or with principles of causal responsibility. Consequently, normative uncertainties about the best course of action are cross-dimensional. For example, the cost reduction principle on a national scale in the short term can constitute trade-offs with concerns for the Global South and future generations.

There is also normative uncertainty about the relations between different tenets of justice. Participants focused on distributive justice, which situates them in the distributive paradigm that "defines social justice as the morally proper distribution of social benefits and burdens" (Young 1990, p. 16). However, this paradigm has been criticized extensively, in part because it ignores or takes for granted institutionalised cultural injustices – such as racism, ableism, speciesism, ageism, and sexism – that can underlie distributive injustices (Young, 1990). For example, participants generally considered their culture 'developed' and the desirable living standard for the rest of the world, devaluing other views on the good life. By taking this cultural hierarchy as a yardstick for distributive justice, they reproduce an idea that can be considered as misrecognition.

4. How Normative Uncertainties were Settled

Despite including a reflection exercise, none of the participants claimed that they changed their minds, only that it made them think a bit more about the social aspects of their technologies. Moreover, there was hardly any explicit disagreement among participants.[6] This raises the question of how they dealt with normative uncertainties on energy justice. Participants seemed to resolve normative uncertainties in three different ways.

First, participants often resorted to utilitarian reasoning and the principle of cost reduction. According to this principle, something is just if it reduces the costs or if it costs less than an alternative. This reduces justice issues to economic sums of gains and losses or morals to markets. Moreover, this type of utilitarian thinking transforms normative uncertainties into *epistemic uncertainties* about the consequences of a certain technology. Techno-optimism colours the probabilities of 'good' outcomes of the technologies, which helped resolve some normative uncertainties. Plausibly, both techno-optimism and utilitarian thinking stem from the scientific and technological background of the participants (Leydens & Lucena, 2018). If this is true, their education has thoroughly influenced how they perceive energy justice.

Second, all participants identified these tensions as political problems and not something experts such as themselves should have to think about. As such, normative uncertainties were sometimes acknowledged and dismissed as political or subjective. For example, distributive justice questions were seen as "*more of a political choice than a technology choice*" (workshop one). According to a participant in workshop three, everyone should have a "*reasonable standard of living. […] But*

[6] This could be because they had just met and that this was a professional context to them.

that's more of a political view, I guess". In workshop four, a participant argued that "*The needs of the privileged people from the global north might be less important than for example marginalized groups or people in the Global South. Um, yeah, that's just my personal, uh, personal point of view*". Moreover, their meta-ethical stance seemed to be that of subjectivism or relativism. For example, one participant in workshop four framed normative uncertainty about the importance of future generations as "*a matter of values*". This finding resonates with early texts on the engineering mindset, such as Gottlieb (1983), who claimed that engineers are generally 'positivists' who strictly separate the domains of knowledge and ethics, the latter being the real of "free and unjustified personal choice" (p. 11).

Third, participants often referred to existing institutional frameworks when faced with normative uncertainty. This point has been made in past research concerning existing codes of engineering ethics that exercise a deontological power (Schmidt, 2014). This study shows that this institutional influence extends beyond ethical guidelines. For example, the well-known milestone of 2050 shaped how participants distinguish between the short and the long term. This hampered the participants in thinking about future generations far beyond 2050. Moreover, the participants were embedded in for-profit business contexts, and it is plausible that this influenced their criteria for good and bad. Similarly, they were tied to (supra)national institutions that regulate the energy transition, such as national or EU governments. Often, the scale of justice matched the scale of their affiliated institution. As stated above, the Post-Its were often considered good or bad for a national or European context, which contrasted with articulated intuitions on global injustices. These moral questions stayed out of sight due to the (supra)national institutional context in which the participants operate. In sum, institutional frameworks – including (supra)national state institutions, education, technology, cultural norms, and business – guided, for a large part, how participants perceived justice and how they resolved normative uncertainty.

Conclusion

This study shows, first of all, that energy storage experts could articulate many energy justice assumptions. Generally, participants held a liberal nationalist perspective, which includes some – but limited – responsibilities towards 'other' countries. Most participants considered only humans as subjects of justice, excluding non-humans. The timeframe was largely determined by the 2050 milestone. Moreover, participants mentioned many different principles of justice, including a sufficiency principle (with the Western lifestyle as a yardstick), cost reduction, and national self-determination. Although these insights cannot be generalised, they say something about the 'norms' and what is considered relatively uncontroversial.

This characterisation of participants' most prevalent normative energy justice assumptions also reveals what assumptions participants did not have. Other assumptions – such as multispecies justice, intergenerational justice, and principles of justice – are reasonably defensible, which amounts to normative uncertainty about energy justice. In other words, the perspectives of participants can be deconstructed as particular (Western) conceptions of justice instead of universal, neutral views. On some topics, participants were able to articulate normative uncertainties. However, normative uncertainties often remained unnoticed, and tensions between different assumptions became visible only in data analysis.

Focussing on normative uncertainty stresses the need to include a more elaborate set of assumptions in energy system decisions. Fostering a just energy transition requires explicit reflection on what is just. Currently, reflection is lacking about what assumptions are held and whether these are the most appropriate. In other words, normative assumptions are taken for granted. However, when a broad set of possible assumptions is considered, and the normative uncertainty that comes with it is acknowledged, a different situation arises. Often-held assumptions may be thoroughly critiqued, and less convincing assumptions may be replaced by others. The 'last assumption standing' might be considered the best one for now. Such debates should be organised in the public sphere, and as such, it is not the sole responsibility of engineers or designers but of ethicists, educators, and society as a whole. Such a project of value change might – slowly but steadily – lead to more just energy systems. This study can be seen as an exercise in empirical philosophy to analyse and reflect on energy justice assumptions in energy innovation, which is a first step towards moral progress.

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