Towards Social Justice in Energy Transitions: An Information Systems Perspective

Martin Brennecke
SnT - Interdisciplinary Centre for Security, Reliability and Trust, University of Luxembourg.
martin.brennecke@uni.lu

Dominik Jurek
Haas School of Business, University of California, Berkeley, California, USA.
dominik_jurek@berkeley.edu

Alexander Rieger
SnT - Interdisciplinary Centre for Security, Reliability and Trust, University of Luxembourg.
Sam M. Walton College of Business, University of Arkansas, Fayetteville, USA.
alexander.rieger@uni.lu

Tamara Roth
SnT - Interdisciplinary Centre for Security, Reliability and Trust, University of Luxembourg.
Sam M. Walton College of Business, University of Arkansas, Fayetteville, USA.
tamara.roth@uni.lu

Abstract

The transition to net-zero energy is typically framed as an environmental sustainability challenge. However, this transition can only be successful if it also considers social sustainability. To provide a basis for this perspective in IS research, we conduct a scoping review on the current state of knowledge surrounding energy social justice. Our review combines traditional qualitative text analysis of 47 papers with natural language processing (NLP) on an expanded set of 267 papers. We find that social justice discussions have picked-up pace since 2016 with a noticeable jump in 2020. However, they focus only on specific topics and are limited to the energy and social sciences. To transfer concepts and knowledge from these disciplines into IS and guide the filling-in of blank spots, we present a conceptual framework for IS research on energy social justice.

Keywords: energy justice, social justice, energy transition, structured literature review, natural language processing.

1. Introduction

Environmental sustainability considerations have and continue to incentivize numerous IT projects across the globe, particularly in Europe (Akande et al., 2019; Lytras et al., 2021; Seidel et al., 2017). Most projects aim to promote the uptake of renewable energy sources, seek ways to stabilize grids with a high share of these energy sources, or to nudge more responsible consumer behavior (Fridgen et al., 2016; Piel et al., 2017; Stieglitz et al., 2023). While many projects are essential to reduce the dependency on fossil resources and support more environmentally friendly practices, they often do not consider the various social challenges that come in tow with the tremendous changes they propose. In fact, digital initiatives may exacerbate energy insecurity in low-income communities and communities of color (Van Bommel & Höffken, 2021).

Smart meters are a case in point. While the installation of these meters in homes and businesses will support the integration of renewable energy sources, it also comes at significant costs. In some countries, smart meters are subsidized to reduce the burden on homeowners and businesses, in other countries, the costs are not shared equitably (ICCS-NTUA & AF Mercados EMI, 2015). In Germany, for instance, the financial burden will be primarily carried by homeowners, but they cannot 'opt out' (Jones, 2023). Even in cases, where the financial burden is in part with the government, a socially sustainable outcome cannot be guaranteed. Recent studies, for instance, have cast a shadow over the use of information technology to facilitate local energy communities. Many different factors ranging from digital literacy to resource availability, network effects, and policy can influence the level of social justice in such energy communities (Knox et al., 2022).

Despite potential social injustices of current solutions, a digitally supported transition of energy systems is essential. To ensure that this transition is also socially

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sustainable, we aim to enhance the understanding of social justice in energy initiatives. Thus, we want to answer the following research question:

How are social justice and social injustices discussed in the current energy (systems), information systems, management, and public administration literature?

We answer our question by collecting a sample of academic texts on energy transition and social justice and perform a systematic literature review to identify contexts and dimensions of social justice (Page et al. 2021; Paré et al. 2015; Webster & Watson 2002). We first quantify a broad corpus of current literature on energy and social justice based on the qualitative criteria from our literature review. This helps us identify the most underserved dimensions of justice and the contexts in which they influence social outcomes. Based on our analyses, we provide an overview of where IS can bridge knowledge gaps to better integrate social justice dimensions in energy research and sustainable designs. Finally, we introduce a differentiated social justice dimension to Sovacool et al.'s (2021) established meta-theoretical energy justice framework. Decision-makers in energy projects can use this framework to better reflect energy justice considerations in the design and execution of their projects.

2. Background

Four billion people worldwide suffer from energy poverty, which has negative effects on both their private and professional life[1]. In an increasingly digital world, a socially just distribution of energy across energy systems is paramount (Sovacool et al., 2016). Literature typically suggests a technology-mediated transition from fossil fuels to renewable energy sources to improve access to affordable energy (Jenkins et al., 2016). Proposed transitions, however, often only benefit a select few instead of tackling energy poverty. For others, these approaches have "the potential to worsen [the] pernicious collection of wicked problems by either exacerbating existing inequalities or introducing new vulnerabilities" (Sovacool et al., 2021). This applies at both the global and the national level (Hanke et al., 2021; Van Bommel & Höffken, 2021).

While energy research and ongoing energy projects try to consider but do not focus on energy justice, the academic discourse – particularly at the intersection between energy systems and social sciences – has been heated in recent years. This discourse focuses primarily on questions of "how a society or group should allocate its scarce resources or products among individuals with competing needs or claims" (Roemer, 1998). Frameworks developed at this intersection aim to provide guidance for a better incorporation of justice evaluations into the management of energy supply and demand (Jenkins et al., 2016; Sovacool et al., 2021).

Furthermore, energy and climate change researchers suggest that making use of emerging digital technologies could lead to a more just energy transition by lowering participation thresholds and giving users more control over their consumption. Yet, initiatives focused on leveraging the capabilities of emerging technologies in energy systems rarely consider social justice. In some cases, they may even exacerbate energy insecurity across low-income communities and communities of color where the digital divide prevents users from accessing new technologies (Van Bommel & Höffken, 2021).

Thus, bringing digital technologies into the fold, requires an even better understanding of the interplay between social justice and innovation in the energy sector. Academic literature provides a wealth of studies that evaluate, for instance, various organizational approaches (Keeley, 1978), such as measures aimed at integrating distributive and procedural justice evaluations of positive and negative outcome allocations (Törnblom, 1999) and measures focused on procedural and restitutive justice for better policies on retrofitting (Grossmann, 2019). Although information systems would be best equipped to extend this academic knowledge with a more socio-technological perspective, these studies are currently limited to energy research and social studies.

3. Research Process

We conduct a structured review of the existing academic literature based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) model (Page, M.J. et al., 2021). We follow a three-step process covering the identification, screening, and inclusion of studies. We focus on the academic literature in information systems, management, energy, and public administration research and the number of outlets listed in Table 1.

[1] According to Sovacool (2014), as both energy and poverty have different definitions based on where, when, and how they are referred to, there are also various definitions for 'energy poverty.' We follow Shahzad et al. (2022), who "understand energy poverty as a lack of affordable, adequate, reliable, environmentally friendly, and safe energy services for development."

We cover an extended AIS Senior Scholar's List of Premier Journals in information systems research, the Financial Times 50 (FT50) ranking in management research, as well as the top ten percent of scientific outlets in energy and public administration, as ranked by Scopus.

Table 1: Number and type of outlets included by discipline.

Discipline	Based on	Outlets included
Information systems	Extended List of Premier Journals (AIS)	13
Management	Financial Times 50 ranking	50
Energy	Scopus top ten percent	100
Public administration	Scopus top ten percent	36

Within these outlets, we search for records using the search strings shown in Table 2 and add snowball sampling to achieve saturation (Webster & Watson, 2002). Since we aim for explanation building, we draw on both empirical and conceptual studies to conduct a theoretical review and develop a conceptual framework (Paré et al., 2015). In line with this type of literature review, we apply a concept-centered approach (Boell & Cecez-Kecmanovic, 2015; Kitchenham, 2004; Kitchenham & Brereton, 2013) rather than a critical, realist, or narrative one (Paré et al., 2015).

Table 2: Search strings used.

#	Search string	Records
A	("Energy" OR "Electricity") AND ("Justice" OR "Injustice")	596
B	("Energy" OR "Electricity") AND ("Social Justice" OR "Social Injustice")	74
C	("Energy" OR "Electricity") AND ("Responsibility" OR "Fairness")	1,027
D	("Social" AND "Justice" AND "Evaluation")	57

In total, our search strategy returned 1,754 records. In the first step of the selection process, we remove 27 duplicate records and mark seven records as ineligible. Hence, we consider 1,720 out of 1,754 records for manual screening. Only three of these records have been published in core information systems journals.
In the second step, we screen a total of 1,720 records and manually exclude 1,579 since they either only contained keywords but were not within the scope or were not focused on the interplay of social justice and the energy transition. Specifically, we exclude 1,185 records based on a manually conducted title search, 268 records based on a manually conducted keyword search, and 126 based on a manually conducted abstract search. Two of the co-authors conduct the selection independently from each other using the same inclusion and exclusion criteria, that is, a focus on energy justice, energy social justice, and justice in energy transitions. After each search, they discuss the inconsistencies between the individual assessments and jointly decide.
For the third and final step, we drop another 94 records based on relevance, leading to our final sample of 47 records. We provide an overview of our research process based on the PRISMA guidelines in Figure 1.
After manually and independently coding the 47 records that passed the abstract search into contexts and dimensions of justice, we use computational methods from natural language processing (NLP) in section 4 to identify trends over an expanded sample of 267 records that pass both the title and keyword search but are excluded in the abstract search.

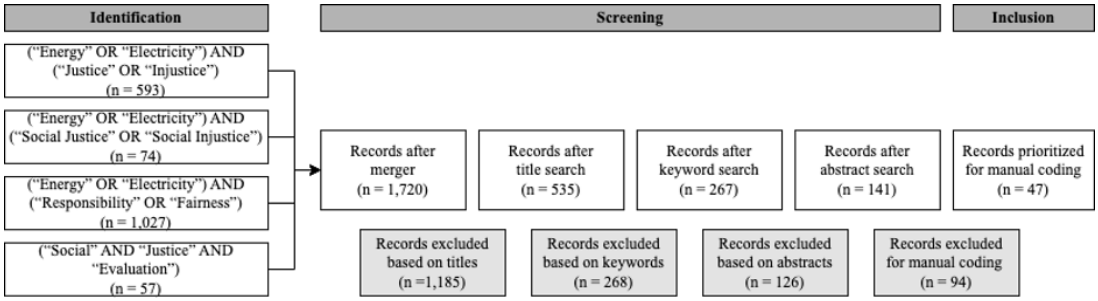

Figure 1. Record identification, screening, and inclusion based on PRISMA flow diagram.

4. Results

Using traditional coding techniques and the qualitative data analysis software MaxQDA on our selected literature sample, we find that various energy justice frameworks have been proposed and persist in the academic discourse. We present an alphabetically sorted overview of the most prominent featured frameworks, including their justice considerations, mechanisms, evaluations, as well as contributions in Table 3.

Table 3: Selected energy justice frameworks.

Frameworks	Justice Considerations	Mechanisms/Evaluation	Contribution
Ciplet (2021)	Economic rights, environmental rights, social rights.	Embedded representation in the form of economic, environmental, and social embeddedness.	A framework that merges sustainable development and energy justice concepts.
Elmallah et al. (2022)	Geography and socioeconomic contexts; climate, environment, and housing justice; green jobs and just economic development; just energy transition and sustainable development; transportation equity; climate resilience; just transition for workers.	Six principles of just energy: addressing the root causes and legacies of inequality, being place-based, shifting the balance of power in existing forms of governance, adopting a rights-based approach, rejecting false solutions, creating new/cooperative/participatory systems of energy governance and ownership.	Inclusion of the perspectives of organizations that engage with energy justice but do not have an energy-focused mandate. Future-oriented by focusing on visions and plans.
Heffron & McCauley (2018)	Climate, energy, environment.	JUST-Transitions, in the form of justice, universal, space, and time.	A framework that integrates climate, energy, environment consideration with legal geography.
Heffron et al. (2018)	Economic, political, environmental questions.	Balancing act between the energy trilemma issues of economics, politics, and environment.	An energy justice metric, modeling energy justice using a ternary plot where energy justice performance can be transferred directly onto the energy trilemma.
Hoffman et al. (2021)	Agency in institutional works, imaginaries, and energy justice.	Cyclical framework: triple re-cycle in the form of re-imagining, re-coding, and re-configuring.	A framework to investigate the alignment of the energy transition and social equity.
Kumar et al. (2017)	Social, organizational, environmental, economic, technical questions.	Multi-criteria decision-making in energy planning, consideration of social/ethical, organizational/institutional, environment, economic, and technical sustainability indicators.	A summary of multi-criteria decision-making techniques, applied to renewable energy and sustainable development.
Müller et al. (2022)	Energy justice, water justice, and climate justice.	Six-dimensional concept of hydrogen justice that includes procedural, distributive, restorative, relational, recognition, and epistemological justice.	A conceptual framework for hydrogen (in)justice for transition research, to identify injustices and to set conditions.
Sovacool & Dworkin (2015)	Temporal, economic, socio-political, geographic, technological questions.	Energy justice decision-making tool and principles: availability, affordability, due process, transparency, accountability, sustainability, intra-/inter-generational equity, responsibility.	A synthetic framework for energy justice that aims to resolve energy related dilemmas.

The overview of existing energy justice frameworks in Table 3 and the manual review of the final sample of articles in section 3 allow us to identify two main features of the academic discourse for the classification of social energy justice literature: context and dimensions of justice. We find that economic and climate considerations dominate the recent academic discourse and existing studies overwhelmingly focus on distributive, procedural, and restitutive justice dimensions. Thus, for the quantification of social justice in the academic literature, we consider the use of justice-related language regarding its distributive, procedural, and restitutive nature and in the contexts of social, energy, economy, and climate.

Quantitative analysis.

Based on the most prominent contexts and dimensions of social justice included in the frameworks, we use NLP methods to analyze the use of social justice concepts across the academic literature in the broader sample of literature that passes both the title and keyword search as described in section 3. The goal is to understand what dimensions of justice are prevalent across time in different contexts of the academic literature on energy research. Our quantitative analysis has three main results. First, the number of articles discussing energy and justice has recently increased, especially since 2020. Second, most articles at since intersection are published in social sciences outlets. And third, the restitutive justice dimension only plays a minor role in energy literature.

Our analysis method involves two steps: We train a text classification model to identify different dimensions of justice and contexts using the 47 coded articles from that fit our strictest criterion selection criteria (see Figure 1). We then categorize the full texts of articles that fit the broader scope of our keyword search (267, see Figure 1) according to their context and measure the importance of references to the justice concepts.

We use the coded articles in MaxQDA to tag text passages that either refer to the three dimensions of justice – procedural, distributive/distributional, and restitutive/restorative justice – or the contexts in which justice dimensions are discussed, that is energy, social, business/economics/tradeoffs, and climate/environment. These tagged text passages function as the training data for our NLP classification models. We tokenize the training texts and use word counts to represent the language in the passages as numeric vectors. We adjust the vectors with TF-IDF weights to increase the relative importance of unique terms for each context and dimension of justice (Gentzkow et al., 2019). Based on the weighted vector representation of the text passages in the training data, we fit a support vector classification (SVC) model with linear kernel.

We train two separate models for the contexts and the dimensions of justice. The model for the dimensions of justice works well with 0.72 average accuracy, 0.73 average precision, and 0.69 average recall. The context classification model only achieves an accuracy of 0.51, 0.52 average precision, and 0.53 average recall. However, the context model is reasonably good for the context classification of a large corpus.

We collect PDF copies of the broader set of 267 articles that passed both the title and keyword search but are excluded in the abstract search and feed the full texts into our two classification models. Our context classification model predicts the context of each article and the dimensions model assigns probabilities indicating how well the language of the article fits to each of the three dimensions.

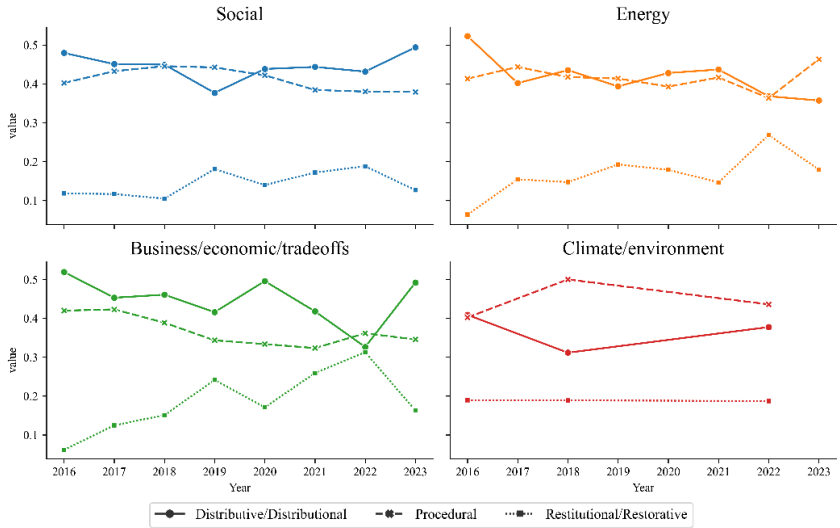

Figure 2: Timeseries of justice dimensions by context.

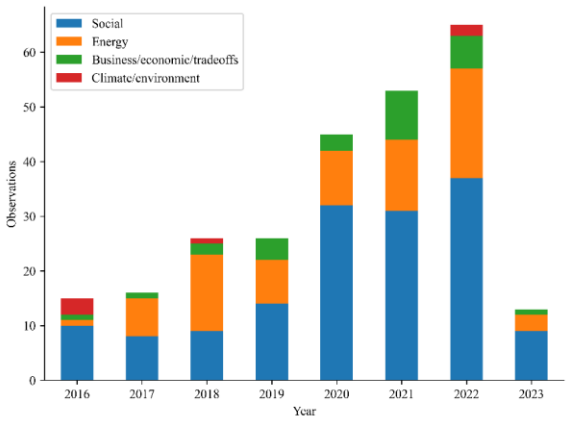

Figure 3: Observations by context over time.

Figure 3 shows the number of classified articles by publication year and the distribution of the assigned context labels. The number of published articles that passed the title and keyword search but not the abstract search has been rising since 2016 with a noticeable jump in 2020. The analysis of contexts for each article shows that more than half of all published articles are in the category 'Social' while most of the remaining articles can be placed in the 'Energy' context.

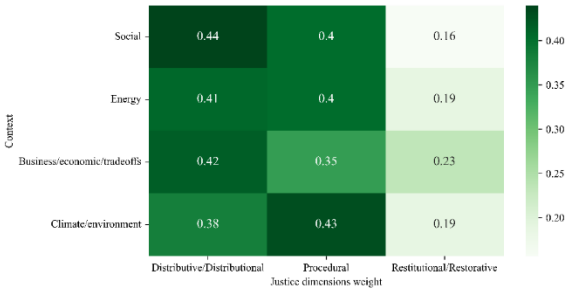

Figure 4: Heatmap of justice dimensions.

The 'Business/Economics/Tradeoffs' and 'Climate/Environment' contexts account for only few observations. Thus, the discussion of justice dimensions has primarily taken place in 'Social' and 'Energy' contexts and has become more important over the last three years.

For Figure 4, we calculate the average probability weights for the three dimensions of justice within each context group. This helps us estimate how important language related to each dimension of justice is for the respective contexts. The heat map graphic shows that language related to 'Restitutive/Restorative' justice is used least across any of the contexts, while 'Procedural' and 'Distributive/Distributional' justice language appears to be evenly distributed and important.

For Figure 2, we group articles in each context according to their year of publication and measure how the weighting of different justice dimensions changes over time. This analysis supports our results and shows that 'Restitutive/Restorative' justice only plays a minor role over the entire sample period in the 'Energy' and 'Social' contexts.

The 'Business/Economics/Tradeoffs' and 'Climate/Environment' contexts have only few observations across our article sample, which leads to missing values and higher volatility for the estimated weights on the justice dimensions. Among the few articles that have a 'Business/Economics/Tradeoffs' focus, the 'Restitutive/Restorative' justice dimension is underweighted. This confirms our observations for the 'Social' and 'Energy' contexts and shows that the 'Restitutive/Restorative' justice dimension is least represented across the entire academic literature at the intersection between energy research and social justice.

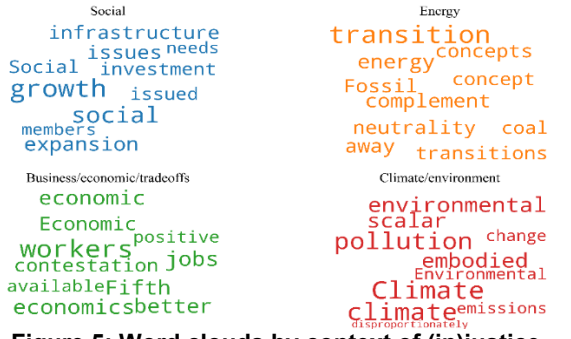

Figure 5: Word clouds by context of (in)justice.

To understand which words are most important for the classification into different contexts and dimensions of justice, we use LIME (Local Interpretable Model-Agnostic Explanations) (Ribeiro et al., 2016). LIME approximates how important specific words are to each label in the NLP models by measuring how classification outcomes change if certain words are dropped from a text. We create the word clouds in Figure 5 and Figure 6 for each classification and adjust the font size according to the estimated importance the assigned and specific label.

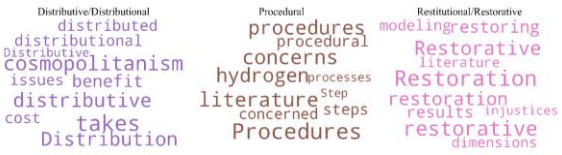

Figure 6: Word clouds by justice dimension.

In both classification models, the keywords in the class titles are most relevant for a specific classification outcome. Especially for the dimensions model, the explicit naming of a justice dimension defines which label is assigned. Since we consider only academic

texts, we assume that common terms are used to refer to the same concepts. Thus, the keywords that define our labels and the dominant dimensions in Table 3 are most useful to identify the dimensions and contexts in our NLP models. Furthermore, the `Social' context puts weight on growth and investment related terms, which shows how the discussion of resource allocations from the social sciences dominates the discourse of justice in the energy context.

5. Discussion

Based on our qualitative and quantitative analysis of the literature, we show that procedural, distributive, and restitution are the most prominent dimensions of justice in the academic discourse on social justice in energy research. We find that the number of articles discussing energy and justice has increased over the past years. Most articles in the context 'Social' discuss resource allocation, which often correlates with distributive justice considerations. However, restitutive justice, which presents a key perspective to the improvement of current energy transition designs, is the least discussed justice dimension. Considering the rising importance of social justice in energy research and increasing use of digital technologies to improve designs, one-sided justice discussions focused only on specific contexts may provide only little guidance to a fundamental improvement of energy justice. Thus, information systems researchers are well positioned to consolidate the knowledge from energy research, social sciences, and digital innovation literature and improve justice outcomes. Practitioners may use this knowledge to leverage the potential of digital technologies in the design of their projects and to account for the interplay of different justice dimensions across contexts.

A first starting point for information systems researchers could be the consideration of 'Restitutive/Restorative' justice. This so far understudied dimension of justice could function as an important tool to rectify historical and ongoing injustices of energy transition designs. More specifically, the targeted use of information systems for 'Restitutive/Restorative' justice could improve the design of energy systems in four ways. Alongside the other two dominant justice dimensions, this digitally mediated implementation of social justice may also better account for the complexity of socially just energy systems designs and may thereby extend the established meta-theoretical energy justice framework by Sovacool et al. (2021) (see Figure 7):

1) Data collection and analysis: Information systems can be used to gather and analyze data related to energy production, consumption patterns, and the social and environmental impacts of different energy sources. This data can help identify the communities or individuals who have been disproportionately affected by the existing energy systems. By analyzing this data, decision-makers can understand the extent of the injustices and design appropriate restitutive measures.
2) Transparent and participatory decision-making: Information systems can facilitate transparency and inclusivity in decision-making processes related. Through online platforms, marginalized groups can become stakeholders in the decision-making process and can help facilitate equitable outcomes through co-creation and co-production. It would also allow them to voice concerns early on and continuously, ensuring that their perspectives are taken into account.
3) Resource allocation and prioritization: Information systems can assist in the equitable allocation of resources and prioritization of restitutive actions. By integrating socio-economic and environmental data, these systems can identify the areas or communities that require immediate attention and support. This helps ensure that restitutive efforts are targeted towards those who have been most affected by past injustices.
4) Monitoring and evaluation: Information systems enable the monitoring and evaluation of restitutive initiatives to assess their effectiveness and make necessary adjustments. By collecting and analyzing data on the implementation of restitutive measures, decision-makers can determine if they are achieving their intended goals. This information can inform future policies and actions, ensuring an iterative and adaptive approach to restitutive justice in the energy transition.

Thus, 'Restitutive/Restorative' justice can be considered a key element to deliver and iteratively improve social justice throughout the design phase of solutions, i.e., thecore perspective of 'responsible research and innovation' (Sovacool et al., 2021), for the energy transition. Since this justice dimension is highly dependent on the local context and the nature of injusties being addressed, other more generalizable dimensions of social justice, such as procedural and distributive justice, may serve as the baseline for design decisions. More specifically, different social justice dimensions may dominate within the core perspectives introduced in Sovacool et al.'s (2021) energy justice framework.

The most researched and most prevalent core perspective, that is 'social practices', is highly driven by cultural values and moral routines (Frese, 2015).

'Distributive/Distributional' justice considerations appear to be a natural fit for this perspective, since they acknowledge that energy injustices are deeply rooted in social structures, institutions, and power dynamics (Hailes et al., 2021). The unequal distribution of energy benefits and burdens is often a result of historical and systemic factors that disadvantage certain communities and populations (Fernandes-Jesus et al., 2020).

For the more detached and normative core perspective of 'energy justice', 'Procedural' justice considerations may support the evaluation and concretization of social justice. More specifically, procedural justice is a natural fit for the core perspective of energy justice as it promotes inclusive decision-making, transparency, accountability, access to information, and procedural safeguards (Siciliano et al., 2018).

By incorporating procedural justice principles into energy decision-making processes, the framework aims to ensure that energy transitions are carried out in a fair, equitable, and participatory manner, where the voices and interests of all stakeholders, especially marginalized communities, are respected and considered (Törnblom, 1999).

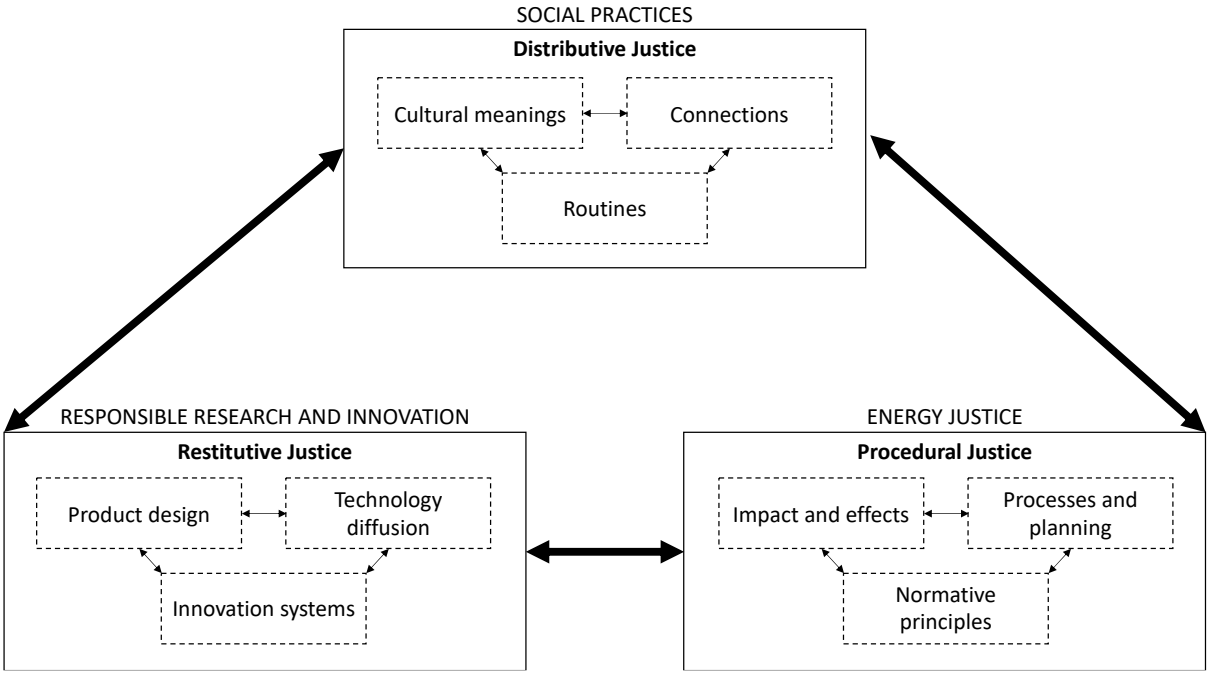

Figure 7: Justice dimensions allocated to Sovacool et al.'s (2021) core perspectives for a continuous improvement of social justice during the energy transition.

Moving forward, the information systems community should also identify opportunities and strategies for resolving social justice tensions with the help of digital technologies. That is, digital technologies may help balance prices, enable access to affordable energy, and issue penalties for profit maximization at the expense of the disadvantaged. They may also automate regulation and introduce democratic governance structures that prevent concentration of power in energy communities along lines of wealth. For either of these applications, our proposed tentative extension of Sovacool et al.'s (2021) meta-theoretical energy justice framework provides a suitable framework for the evaluation of new digital technologies and their effectiveness for the goal to achieve social justice in energy transition projects. Other social justice tensions that could be considered and addressed with our process within the discipline of information systems may affect preservation (efforts to protect the environment) and utilization (efforts to harness the potential of the environment) against the backdrop of economic goals and the need to change practices (Jenkins et al., 2016; Sovacool et al., 2016).

Considering the practical and academic potential for the information systems literature, future research should consider expanding the sample further and taking a computationally intensive research approach to the topic of energy social justice, thereby refining the concepts we identified in the body of academic literature. In line with Jenkins et al. (2018), future

research may further investigate which areas of (information) systems research are particularly suited to advance the causes of social and energy justice and adapt our process for context specific use cases.

6. Conclusion

Our research provides insights into the current state of the academic literature of energy social justice and quantifies the most important contexts and dimensions of justice. We find that the discussion of social justice particularly in the social and energy context centered around resource allocations has become more important in recent years and that distributive and procedural justice dimensions are more prominent in the discussion than restitutive justice.

Bearing in mind these imbalances as well as recent political and economic developments, the continuous inclusion of social justice considerations in digitally enabled energy transition projects could create an opportunity to overcome the climate crisis in a socially just way and move us closer to a sustainable energy system. From a meta-perspective, the incorporation of a social justice perspective into the design and evaluation of energy-related innovation projects and processes is key for a sustainable energy transition (Jenkins et al., 2016).

To this end, we develop a tentative extension of Sovacool et al.'s (2021) meta-theoretical energy justice framework to support legislators, researchers, investors, and project managers in the inclusion of social justice dimensions into energy transition projects based on our qualitative and quantitative literature review of social justice dimensions in the current academic literature. The insight into the direction of the discourse and the process framework will help the information system community to redirect its goals and objective towards a more effective accounting for social justice considerations in academic and practical discussions of digital technologies supporting energy transition projects.

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