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# Peer to Peer Energy Trading and Energy Justice

A Systematic Literature Review

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# Abstract

The application of peer-to-peer (P2P) models to energy trading is proposed as a means to enhance accessibility and equitable distribution of sustainable energy. However, the relationship between P2P energy trading (P2PET) and energy justice is underexplored. This thesis addresses this gap by systematically reviewing existing literature to understand how P2PET configurations influence energy justice. The guiding research question is: What factors influence the likelihood of P2PET affecting energy justice? Utilising a systematic literature review with thematic synthesis and elements of a meta-narrative review, this study finds that P2PET can produce both direct and indirect effects on energy justice. Key factors include reliance on smart technologies, geographical and economic contexts, participant behaviour, and socio-technical dynamics. The review also highlights the lack of legal frameworks to protect participants, underscoring the need for regulatory measures to ensure fairness and accountability. While P2PET aligns with ideals of the sharing economy and decentralisation, the absence of empirical evidence translating these ideals into practice is notable. These findings emphasise the need for robust regulatory frameworks to realise P2PET's potential in promoting equitable energy access and distribution.

Keywords: peer to peer, energy trading, energy justice, socio-technical configuration, sharing economy

# Introduction

As the world moves towards a more sustainable future, the energy markets are being reshaped by the global rise of distributed energy resources (DERs), decentralised microgrids, and online trading platforms. One of the emerging configurations in this evolving landscape is peer-to-peer energy trading (P2PET). P2PET offers an innovative approach to sourcing and distributing energy by enabling networks of small-holder prosumers equipped with DERs — energy generation units used for subsistence energy production. However, the fluctuating nature of energy production by DERs often results in surpluses or deficits. P2PET addresses this challenge by connecting these prosumers, facilitating efficient energy management and allowing them to sell and purchase locally produced renewable energy within a decentralised network. Taking into consideration the innovativeness of P2PET, its potential to attract a diverse range of participants is widely discussed in the academic debate.

To mention some, according to Soto et al. (2021), P2PET prosumers can benefit by selling energy below retail prices, while non-producers can source their energy locally. Noor et al. (2018) highlight P2PET's potential to provide energy to remote areas and reduce dependence on centralised suppliers. And by Zhou et al. (2020), P2PET is seen as a potential solution to the energy trilemma, addressing sustainability, availability, and reliability. However, the existing research also suggests that the impact of P2PET services may extend beyond their intended areas, potentially altering social dynamics. Studies on the social aspects of P2P services indicate that these configurations can significantly influence social structures. Schor (2016) notes that P2P services, rooted in participatory and collaborative principles, can reshape organisational and social dynamics, potentially impacting social justice. Despite rhetoric portraying P2P services as enablers of a more democratic and just society, emerging evidence challenges these claims. Research across various P2P applications reveals that such services may introduce and perpetuate inequalities and shift risks onto users.

Energy trading, as a P2P model application, remains relatively new and understudied, with most research focusing on technological and business solutions. Thus, the optimistic rhetoric about P2PET's contribution to sustainable energy transition primarily stems from these fields. Meanwhile, the social impacts, particularly concerning energy justice — a specific instance of social justice — remain largely unexplored (Jenkins et al., 2018). Given the negative social justice effects observed in other P2P sectors, questions about P2PET's impact on energy justice are increasingly relevant. This thesis aims to address this knowledge gap by examining the relationship between P2PET and energy justice through a systematic literature review.

The guiding research question is: "What factors influence the likelihood of P2PET affecting energy justice?" To answer this, a systematic literature review was conducted, accessing articles from Scopus and Web of Science. A multi-stage thematic analysis and thematic synthesis with elements of meta-narrative analysis were employed to interpret the findings. This approach aims

to provide empirically grounded insights into P2PET's energy justice effects. The analysis scrutinises key themes, research areas, and evidence to reveal the current frontier of knowledge and identify gaps, assumptions, and biases. The discussion section relates these insights to critical perspectives on the sharing economy. This research addresses a critical gap in understanding the social implications of emerging energy technologies, focusing on articles with direct empirical data. The findings aim to inform policymakers, stakeholders, and the academic community about the potential benefits and drawbacks of P2PET adoption on energy justice.

The thesis is structured as follows: In Chapter 1 the theoretical framework underpinning the research is introduced. This chapter establishes the research perspective and outlines the pertinent debates shaping the objectives of the thesis. Chapter 2 details the research methods employed, providing a comprehensive description of the research process. In Chapter 3 an overview of the literature reviewed in this thesis is offered, aiming to acquaint the reader with the breadth and scope of the covered literature. Chapters 4, 5, and 6 present the empirical findings of the analysis. Lastly, Chapter 7 discusses the findings, analysing the energy justice implications of P2PET within the broader discourse on the sharing economy.

## **Chapter 1: Theoretical Context**

The theoretical context of this research is anchored in two streams of academic literature, and therefore has two sections. The first section delves into the literature surrounding the sharing economy, aiming to introduce this phenomenon and the academic discourse surrounding it. The objective behind introducing this academic debate is that it serves as a good starting point to initiate the discussion about the prevailing rhetoric and narratives concerning peer to peer (P2P) services and the justice topics. And also introduces the academic grounds upon which the justice impacts of P2PET as a practical manifestation of the sharing economy concept can be critically examined and challenged. This academic debate is further used in the discussion section of this thesis, to interpret and contextualise the findings of the analysis. The second section addresses the particular form of justice studied in this thesis. Here, the concept of energy justice is introduced as a subset of social justice, representing an assumed impact area of P2PET. To operationalise the term energy justice, the three-tenet energy justice framework proposed by Jenkins et al. (2016) is presented, as it is further used as the main analytical framework utilised in this thesis.

### **1.1 Sharing Economy**

Following the Global recession of 2008 and facing unsustainable consumption patterns, the aims to dematerialise and encourage a more democratic and equitable economic system produced various new conceptions. The result of this academic discussion is the umbrella term sharing economy. It is used to refer to economic approaches like collaborative consumption, peer production or P2P economy, which have quickly gained popularity among academics, activists,

and entrepreneurs (Selloni, 2017). According to the findings of a literature review by Curtis and Lehner (2019), it can be understood as an economic approach that focuses on: “access over ownership, by leveraging the idling capacity of goods and services, in order to reduce our overall consumption and subsequent resource use” (p. 2). They also conclude that the term is usually used for business models and practices that share these characteristics: “ICT-mediated, non-pecuniary motivation for ownership, temporary access, rivalrous and tangible goods” (p. 16). Despite multiple aims to conceptually define the sharing economy, the novelty of the concept and the heterogeneity of the configurations that are encompassed by it call for a more applied definitional approach.

Among the academics striving to provide an applied conceptualisation of the sharing economy, Botsman and Rogers (2010, as cited in Selloni, 2017) propose to study the motivations and the type of practices shared by the agents of the configuration. The authors distinguish between sharing and collaborative models. The sharing model is motivated by increasing the monetary or non-monetary benefits from privately owned but underutilised assets by making them accessible to a network of peers. Meanwhile the collaborative models introduce a broader notion of “sharing” by embracing activities such as joint production, trading, and swapping between peers. However, the motivating intention remains fairly similar to the sharing model – to provide or increase the level of access to assets and services. Although Botsman’s and Rogers’ typology touches upon the social implications of the respective configurations, it is constructed and interpreted through an economic lens. However, it is not only the case of Botsman and Rogers. To adopt an economic lens to study and interpret the discussed phenomenon is a common approach in the current academic debate. It can be observed in the work of the authors presented so far by noticing the focus on optimization of resources or access, and increasing monetary and non-monetary benefits present in their attempts to describe the phenomenon. Despite its wide recognition, the economic focus of this strand of literature is also being criticised in the academic debate for being too narrow and superficial to capture the studied phenomenon.

Jemielniak and Przegalinska (2020) argue that the economic lens used to describe the phenomenon hidden under the term sharing economy merely captures the symptoms of a larger societal transformation. The authors state that “the new modes of technology-enabled interactions and their cooperative character are what make those changes so profound” (p. 10). They claim that these social changes cut deeper than the economic matters, and therefore they use the term collaborative society instead of sharing economy. They define it as “an increasingly recurring phenomenon of emergent and enduring cooperative groups, whose members have developed particular patterns of relationships through technology-mediated cooperation” (p. 11). Furthermore, they argue that the phenomenon is closely tied to the idea of collaborative and participatory nature of human beings. Making use of modern communication technologies, the novel configurations and networks, such as P2P services, have the potential to reshape the traditional hierarchies of social structures, procedures, and institutions. As a result of that, complex collaborative processes may be created engaging a broad population of users. The

authors therefore argue that in principle, the collaborative society should favour a more equitable and just society. In agreement with the authors, Schor (2016) claims that the ideological principles of the sharing economy that are being shared among the diverse terms and conceptualizations referring to the phenomenon, do have the potential to create a more democratic economic system.

However, both Jemielniak and Przegalinska (2020), and Schor (2016) question the assumed positive social justice impact the sharing economy can produce when applied in practice. They argue that the sharing platforms – including P2P services – in fact do not build new social networks, nor deepen the relationships within the existing communities. Despite the collaborative rhetoric, risks and responsibilities are being shifted to the users of the services, there is a lack of legal regulations and the social processes enabled by these new platforms are understudied. Thus, the collaborative rhetoric may as well serve to cover for user exploitation, further perpetuating and deteriorating the state of social injustice. Schor is also rather sceptical regarding the chances to successfully implement the concept on a larger scheme. As she shows, the sharing and collaborative rhetoric is actively being used to raise revenues by for-profit enterprises. Moreover, according to Schor's research, P2P platforms operating in various fields from transportation to hospitality reproduce biases regarding class, gender or race, perpetuate dynamics of unequal opportunities and access.

This section of the theoretical context serves as an entry point introducing the narratives and assumptions surrounding the phenomenon described as the sharing economy and its practical applications. It displays the disparities between the supposed contributions and the already emerging impacts of P2P services on social justice. And, for the purpose of this thesis, I would like to build on this debate and use it to problematise the generally optimistic rhetoric that can be observed in many academic articles concerning the P2PET. However, in the current academic debate on P2PET, the economic lens is prevailing. By conceptualising the service as a transactional network to optimise the energy management of its users (Soto et al., 2021), the social aspects of this configuration are being neglected. Given that the concept of collaborative society has been constructed through critical inquiry and reflection on the sharing economy, it presents a more comprehensive conceptualisation of the transformative process our society is undergoing. And I believe it provides a robust entry point to open the discussion about the social impacts of the P2PET. However, to direct the focus towards the social impacts associated with P2PET, the concept of energy justice will be presented in the following section.

## **1.2 Energy Justice**

Within the realm of technological innovation, P2PET constitutes a component of a broader phenomenon known as the energy transition. According to the interpretation of Jenkins et al. (2018), the energy transition occurs when there is an innovation or alteration in the energy system, affecting its technology, prime mover, or fuel source. This transition, as emphasised by the authors, brings about further transformative effects and processes within the society undergoing the transition.

To examine the social implications of such transitions, the authors advocate for the adoption of the concept of energy justice. As outlined by Jenkins et al. (2016), energy justice represents a specific cross-cutting agenda within justice research. It emerged in response to the energy challenge, a complex interplay of “resource scarcity and population growth in an increasingly unpredictable social and environmental climate” (p. 175). The overarching agenda of energy justice studies is to integrate principles of justice into various domains of energy, including production, distribution, and consumption, as well as policymaking, energy security, and activism, with particular relevance to addressing issues such as climate change. As the authors argue, there are two main reasons to adopt the lens of energy justice for research on innovations and transformations within the field of energetics. Firstly, it can be used to “expose exclusionary and/or inclusionary technological and social niches before they develop, leading to potentially new and socially just innovation” (p. 67). And, secondly, “framing energy justice as a matter of priority at the landscape level could exert pressure on the regime below, leading to the widespread reappraisal of our energy choices, and integration of moral criteria” (p. 67).

The focus of energy justice research is threefold. They strive to examine “(a) where injustices emerge, (b) which affected sections of society are ignored, (c) which processes exist for their remediation in order to (i) reveal, and (ii) reduce such injustices” (Jenkins et al., 2016, p. 175). The comprehensive approach to conceptualising and researching the phenomenon in question is valuable for scrutinising the current state of energy justice, as well as uncovering the mechanisms that affect it and the individuals or groups impacted by it. Thus, this approach is further adopted for the analysis conducted in this thesis. However, since the approach is still highly conceptual, a more tangible framework is needed in order to address such questions. Jenkins et al. (2018) propose a framework which builds on this three-tenet approach to study energy justice. The three tenets are distributional justice, procedural justice, and justice as recognition. These tenets are defined as follows: “[d]istributional justice is concerned with the impacts of infrastructure, justice as recognition represents a concern for processes of disrespect, stigmatisation and othering [...] and procedural justice investigates the mechanisms through which those decisions occur” (pp. 67–68).

This section of the theoretical context aims to situate P2PET within the broader framework of the energy transition, illustrating how the social implications of innovations or alterations in energy systems can be academically approached and researched. In this thesis, the energy justice lens is adopted, and the three-tenet energy justice framework is utilised for its comprehensive treatment of various justice dimensions. By emphasising different types of justice, this framework offers a valuable tool for identifying a wide spectrum of energy justice effects that may be facilitated by P2PET.

### **1.3 Research Objective and Questions**

As demonstrated above, the P2P configurations are at the core of currently popular movements such as the sharing economy or collaborative society. The rhetoric surrounding these movements



portraits the P2P projects and services as the potential enablers of a more democratic, participatory, and just society. However, the promising assumptions are already being challenged in the academic literature. Side by side to this debate, the application of the P2P model to energy trading is said to bring a more accessible and justly distributed access to sustainable energy. However, in order to back these claims academically, the potential causal relationship between the P2PET and energy justice is yet to be studied. To help fill this research gap, the objective of this thesis is to gain a better understanding of this relationship. To do so, a systematic review of the state-of-the-art academic literature is conducted in this thesis. However, rather than providing a scholarly chronology of the reviewed literature, the literature review conducted in this thesis serves the purpose of answering a formulated set of research questions, which is the following:

RQ: What factors influence the likelihood of P2PET affecting energy justice?

SQ1: What processes and practices affecting energy justice are enabled by the P2PET?

SQ2: How do the directly engaged actors of the P2PET shape the identified processes and practices?

SQ3: How do the different parts of the physical infrastructure and energy services of P2PET shape the identified processes and practices?

SQ4: Which external conditions affect the performance of the P2PET configuration in terms of energy justice?

## Chapter 2: Methods

This chapter outlines the research design, detailing the data collection and analytical methods employed in this thesis. To ensure the systematic integrity of this review, a high level of transparency in methodological and analytical choices is essential and must be upheld throughout the research process. Hence, this chapter is organised into three sections. In the first section, the process of the data collection is documented, followed by a section reporting on the screening process, describing the selection procedures and eligibility criteria. The last section of this chapter is dedicated to introducing the research lenses and analytical frameworks used to analyse the findings, and describing the analytical process.

### 2.1 Data Collection

To collect the data a systematic search of academic databases was carried out using the digital databases Scopus and Web of Science. To conduct the search, a search string consisting of five search elements was developed. The general design of the search string is the following: *peer-to-peer AND local energy network AND energy trading AND energy justice AND NOT simulation and modelling*. To see the full list of search terms and the formulation of the search string, see

Appendix A. Each of the search elements was filled with search terms – keywords and their synonyms – that express the substance of the search element. While the choice of the *peer-to-peer*, *energy trading* and *energy justice* search elements stem directly from the objective of the research, the two remaining search elements deserve to be provided with an explanatory introduction.

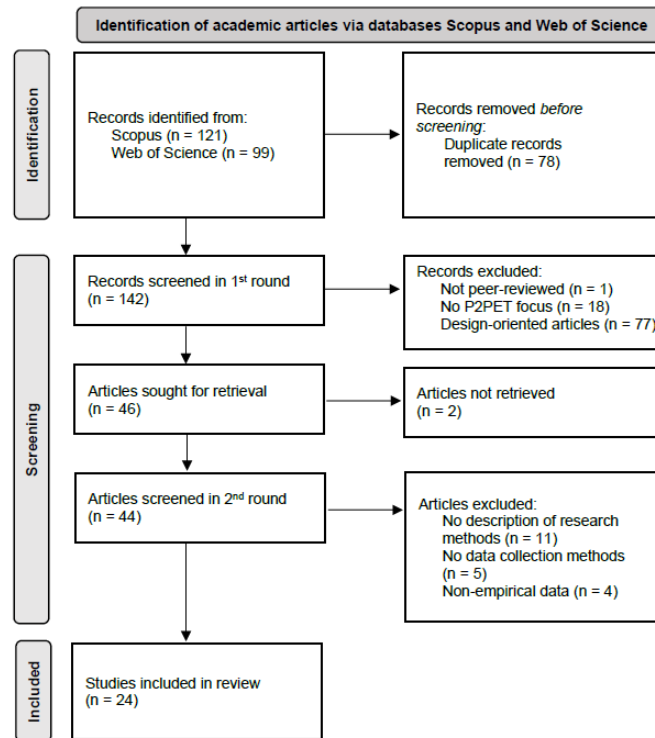
The majority of P2PET research focuses on local networks, however, P2PET is also discussed in relation to other research areas such as mobility. Therefore the *local energy network* search element was introduced to focalise the search. Regarding the *simulation and modelling* search element, as uncovered through the iterative process of search strategy development, the majority of conceptual, design-oriented and generally non-empirical articles, had the common denominator of applying the simulation and modelling methods. Given that the aim of the search strategy was to analyse the real-world applications of P2PET, empirical articles were desired to enter the analysis. Thus the said search element was introduced to the search string in order to decrease the number of non-empirical studies retrieved by the search.

During the search, several filters were used to restrict the search only to journal articles in the final stage of publication and written in English. The search and retrieval of articles was conducted on February 6th 2024. Only articles published prior to that date were eligible for analysis. In total 142 articles, cleared of duplicities, were retrieved and passed to the screening process. In order to maintain transparency and document the decisions taken during the search strategy development process, a logbook was kept by the author of the thesis, and can be consulted in Appendix B. In order to see the definitions of the eligibility criteria, see Appendix A, where these are described and documented.

## 2.2 Screening Process

The screening was conducted in two rounds. The first round covered a title, keywords, and abstract read, with the second round covering a full text read of the articles. In the first round of screening, all the articles that were not peer-reviewed, were design-oriented, or were mismatched through the search explicitly lacking focus on P2PET were excluded. In total, 96 articles were excluded through this round. Out of the remaining 46 articles, 2 could not be accessed with the institutional access provided by WUR, therefore only 44 articles entered the second round of screening. Given the objective of this research, only articles analysing empirical data were eligible. Thus, through the second round, articles were screened for the presence of research and data collection methods description, and type of analysed data. Within this process, 20 more articles were excluded. The remaining 24 articles passed the screening process and were used as the studied body of literature. A summarisation of the screening process is shown in Figure 1. For the process of eligibility criteria development and whilst conducting the screening a logbook was kept by the author, and can be consulted in Appendix B.

Figure 1 - Screening process



## 2.3 Analysis

The P<sub>2</sub>PET is a relatively new and niche topic that at the time of conducting this research still lacks a significant timeframe of an extensive scholarly exploration. This limited history of research poses challenges in conducting a systematic review that could comprehensively outline a scholarly chronology of this research field. For that reason, this literature review does not attempt to do that, but rather focuses on exploring the relevant themes and research directions present in this research area. The systematic literature review conducted in this thesis thus represents an extending hybrid review with thematic synthesis and elements of a meta-narrative review as described by Xiao & Watson (2017).

The main objectives of such a type of study build on the fundamental aims of literature reviews. These are to identify relevant references from the existing literature and identify the current knowledge frontier. In other words, deepen the understanding of academic discussion, uncover key theories and approaches, as well as inconsistencies, limitations and knowledge gaps present across the literature. However, by employing thematic synthesis and meta-narrative analysis, the objective of this review is to further build upon the reviewed literature by analysing the concepts and constructs that are studied in it. Thus, the articles reviewed in this thesis are further used as the input data for the document analysis which is conducted to answer the research questions (Xiao & Watson, 2017). In order to make this objective possible, the analysis is structured into

three distinct stages. The rest of this chapter elaborates on the delineation of these analytical stages, outlining their respective objectives and their significance in answering the research questions.

The first stage of analysis aims to prepare the first part of data and interim findings for the thematic synthesis. At this stage the P2PET configurations present in the reviewed articles are studied. Anchored in the theoretical debate on sharing economy and collaborative society, this stage of analysis builds on a fundamental assumption. This assumption is that the organisational aspect of the P2PET configurations is what produces effects on energy justice. Therefore, in order to study the P2PET configurations, an organisational lens is adopted in this stage. The section 2.3.1 of this chapter introduces said research lens, and describes the analytical methods used to conduct this stage of analysis. The findings of this analytical stage are reported in Chapter 4 of this thesis.

The objective of the second stage of analysis is to prepare the second part of data and interim findings for the thematic synthesis. The energy justice aspects related to the P2PET practice are identified and mapped in this stage. This step is taken given that at the time of conducting this thesis research, the energy justice aspects of P2PET have not yet been systematically mapped nor grounded through empirical data. Thus in order to be able to discuss any potential causal relationships between P2PET and energy justice, it is necessary to first conduct this step. The section 2.3.2 of this chapter describes the analytical methods used to conduct this stage of analysis. The findings of this analytical stage are reported in Chapter 5 of this thesis.

The aim of the third and final analytical stage is to address the research questions. To do so, the thematic synthesis is conducted at this stage. The inputs for the synthesis that discusses the relationship between P2PET and energy justice are the interim findings from previous analytical stages. The elements of meta-narrative are also employed at this stage to maintain a critical engagement with the reviewed literature while answering the research questions. The section 2.3.3 of this chapter introduces the analytical methods used to conduct this stage of analysis. The findings of this analytical stage are reported in Chapter 6 of this thesis.

### **2.3.1 The configurations of P2PET practice**

At the first stage of analysis, the different P2PET models and projects presented and studied in the articles are analysed. Based on the preliminary study of P2PET, a variety of configuration-specific conditions, practices and modes of organisation is expected to be found in the articles. To address this expectation and make the P2PET configurations researchable, an inductive approach and an organisational lens are adopted for this analytical stage. To prepare the data for analysis, an inductive coding is employed. This initial coding process utilises open coding technique, allowing for a consequent identification and categorization of key themes and concepts within the articles. ATLAS.ti software is used to conduct this step.

The P2PET practice is created off of the idea of connecting geographically distributed means of energy production with a decentralised management mechanism in order to allocate energy consumption and mediate energy trading. Thus, to arrive at a comprehensive understanding of how P2PET works in practice, an organisational lens anchored in the work of Wanda Orlikowski (2002) is adopted for this analytical stage. In her research, Orlikowski approaches her study of distributed and geographically dispersed organisations by emphasising their socio-technical character and the importance of contextual information. Besides studying the physical dimension of the organisation such as its infrastructural and technological aspects, she also scrutinises the social dimension of the organisation such as the actors and the processes they engage in. Since the P2PET practice shares the characteristics of organisations studied by Orlikowski, her socio-technical approach is used to study the P2PET models and projects present in the articles.

The aim of this analytical stage is to generate new insights about the socio-technical configurations in which P2PET is operated, and collect evidence on the organisational characteristics of the P2PET configurations. Therefore, a thematic analysis is conducted to analyse the data at this stage. The analytical process follows the inductive approach making use of the initial codes generated through the coding process to identify and categorise key themes and concepts within the articles.

### **2.3.2 Energy Justice Aspects of P2PET**

The second analytical stage is dedicated to the study of energy justice and its relation to the P2PET configurations. Therefore, the justice lens based on the work of Jenkins et al. (2016) is adopted. The conceptualisation of energy justice and the triangular energy justice framework are already described in the theoretical chapter of this thesis. For the purpose of this analytical stage, the energy justice framework is used to identify and classify the energy justice aspects related to the current P2PET configurations. Similar to the preceding stage, the data examined in this phase comprises the textual content extracted from the analysed articles. However, in contrast to the previous stage, a deductive approach is adopted, and the energy justice lens serves to guide the process of codebook development as well as data analysis.

To develop the codebook, the framework proposed by Jenkins et al. (2016) and extended by Fuller and Bulkeley (2013) is used. The initial codes for the distribution tenet are based on the general indicators describing the characteristics of the physical infrastructure and the energy services provided and maintained within the P2PET configurations. These are availability, accessibility and affordability. The initial codes for the recognition tenet aim to identify and categorise situations in which injustice related to the representation and treatment of individuals and groups happen. These are cultural domination, non-recognition and disrespect. And regarding the procedural tenet, the initial codes aim to recollect the rights, responsibilities and recognition in regards to the decision-making processes and practises the individuals, groups and entities engaged in the P2PET have. Considering both the variety of P2PET configurations that may enter the analysis, and the limited state-of-the-art knowledge in the studied field, a low-level of detail-

sensitivity was adopted for the development of initial codes. For the full version of the codebook, see Appendix C.

As the aim of this stage is to identify and map the energy justice aspects related to the P2PET configurations, the method used to analyse the data in this stage is a thematic analysis. To prepare the data, deductive coding is conducted using the codebook to identify the relevant data, and provide an initial categorisation into framework-driven themes. The initial codes and themes were further used to analyse the pieces of data. From this analytical step, new emerging code groups and themes are used to make sense of the evidence and construct findings. To code and organise the data into themes, ATLAS.ti software is used.

### **2.3.3 Themes and Relationships between P2PET and Energy Justice**

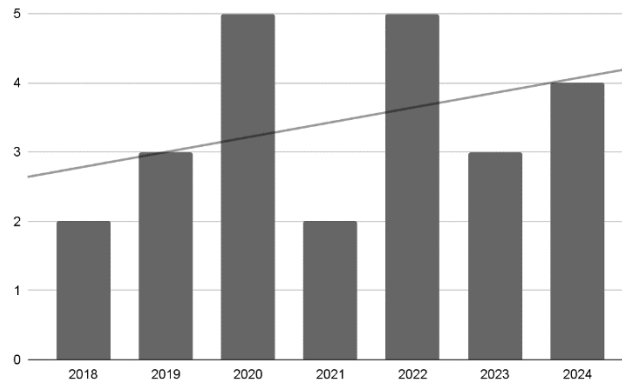
As stated in the beginning of the analysis section, at the time of this research, any potential causal connection between P2PET and energy justice lacked empirical grounding or scrutiny. However, with the completion of preceding analytical stages, such inferences should now be plausible. The objective of this current stage is to answer the research questions and set the stage for subsequent discussion. In pursuit of this objective, a thematic synthesis is conducted. The synthesis draws from the thematic analyses conducted at the previous analytical stages, and even though one of the input analyses follows a deductive approach, the synthesis is conducted inductively.

Since the synthesis makes use of the interim findings, no additional rounds of coding are conducted at this stage. Nonetheless, relying on the reviewed articles as primary data sources in preceding stages may lead to the oversight of vital details concerning research perspectives and context. This oversight may inadvertently introduce bias stemming from the positionality of the articles within the broader academic landscape. To uphold a critical viewpoint and remain actively engaged with the reviewed literature, the coded data from prior analytical stages is revisited. The objective is to identify artefacts facilitating the assessment of the positionality of the reviewed articles. This involves leveraging elements from the meta-narrative review and delving deeper into the literature, with a focus on theoretical frameworks, research lenses, and the academic context of the articles. To answer the research questions, the findings of both the thematic synthesis and the meta-narrative analysis are considered.

## **Chapter 3: Literature Overview**

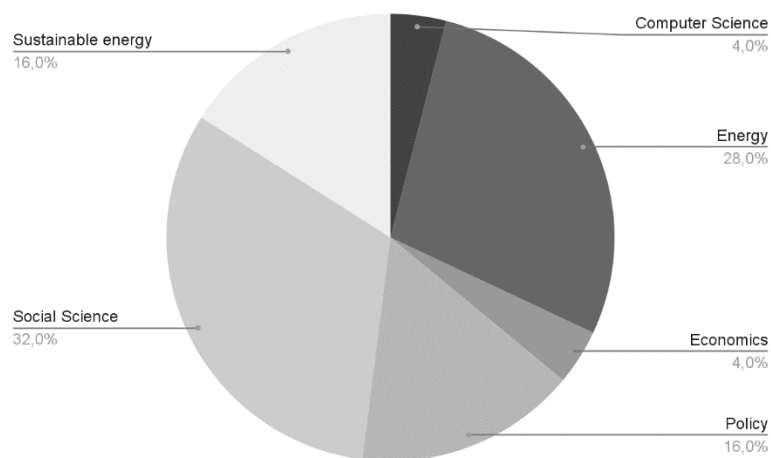
As explained in the methodology chapter, rather than providing a scholarly chronology, the literature review in this thesis serves the purpose of answering a formulated set of research questions. However, to maintain the systematic approach characteristic for this type of study and increase the readability of the following chapters, this chapter presents a descriptive overview of the studied articles. The aim is to introduce the studied articles from within the context of the sample, in order to make sense of them as a body of literature instead of stand-alone papers. And, moreover, to conduct an initial assessment of the studied sample.

Figure 2 - Year of publication



P2PET as a research area is characterised by its novelty and a recent widespread attention within research circles. However, as can be concluded from the screening process conducted to arrive at the final literature sample, design-oriented studies from areas of computer science and engineering are the most prominent among the existing literature. Even though the number of empirical studies is still limited, an increasing amount of such studies conducted in the last years can be observed from the studied sample. Given that the data was extracted in February 2024, it is reasonable to anticipate that more articles meeting the eligibility criteria are likely to be published until the end of this year, supporting this upward trend. The sample utilised in this study is thus exceptionally current, reflecting the most recent developments in the field. Figure 2 illustrates the distribution of publication years for the articles included in this review. The sample encompasses a diverse array of subject areas, ranging from computer science to policy and economics; nevertheless, the predominant research fields are social and energy studies. A comprehensive breakdown of the distribution of articles according to their subject areas is presented in Figure 3.

Figure 3 - Articles by subject area



Within the reviewed sample, two groups of articles can be distinguished based on their limitation of geographical focus. The first group, consisting of 14 articles, is characterised by articles

studying a geographically localised configuration or context such as a specific P2PET project or a national context for P2PET adoption. Notably, the majority of these studies represented in the reviewed sample focuses on countries of Global North. Nonetheless, the P2PET configurations based in Bangladesh are also highly covered by the reviewed literature representing Bangladesh as the P2PET pioneer among the countries of Global South. The remaining 10 articles of the reviewed sample lack the embeddedness in a geographical context, and generally pursue more conceptually-oriented research approaches. These articles either conduct technology-oriented surveys and reviews, or study global experts' opinions. The Tables 1 and 2 respectively present the articles belonging to these groups introducing the research focus of each article included in the review. Furthermore, since the articles act as the input data for analysis further into the thesis, the Tables also introduce shortened tags that are assigned to each of them for practical reasons while reporting on the findings.

*Table 1 - Articles embedded in geographical context*

Groh et al. (2022)	D3	Bangladesh	Study of real-life configuration
Bonfert (2024)	D5	The United Kingdom, The Netherlands, Sweden, Belgium	Study of real-life configuration
Karami and Madlener (2022)	D6	Germany	Study of context, user-focused
Wang et al. (2020)	D8	China	Study of context, legal framework
Li et al. (2022)	D9	South Korea	Study of context, user-focused
Schneiders and Shipworth (2021)	D10	The United Kingdom	Study of context, legal framework
Fell et al. (2019)	D11	The United Kingdom	Study of context, user-focused
Hahnel et al. (2020)	D14	Germany	Study of context, user-focused
Ableitner et al. (2020)	D17	Switzerland	Study of context, user-focused



Paudel and Marungsri (2024)	D18	Thailand	Study of context, economic feasibility
Kirchhoff and Strunz (2019)	D19	Bangladesh	Study of real-life configuration
Singh et al. (2018)	D20	India	Study of real-life configuration
Ecker et al. (2018)	D21	Germany	Study of context, user-focused
Khan (2019)	D23	Bangladesh	Study of context, user-focused

*Table 2 - Conceptually oriented articles*

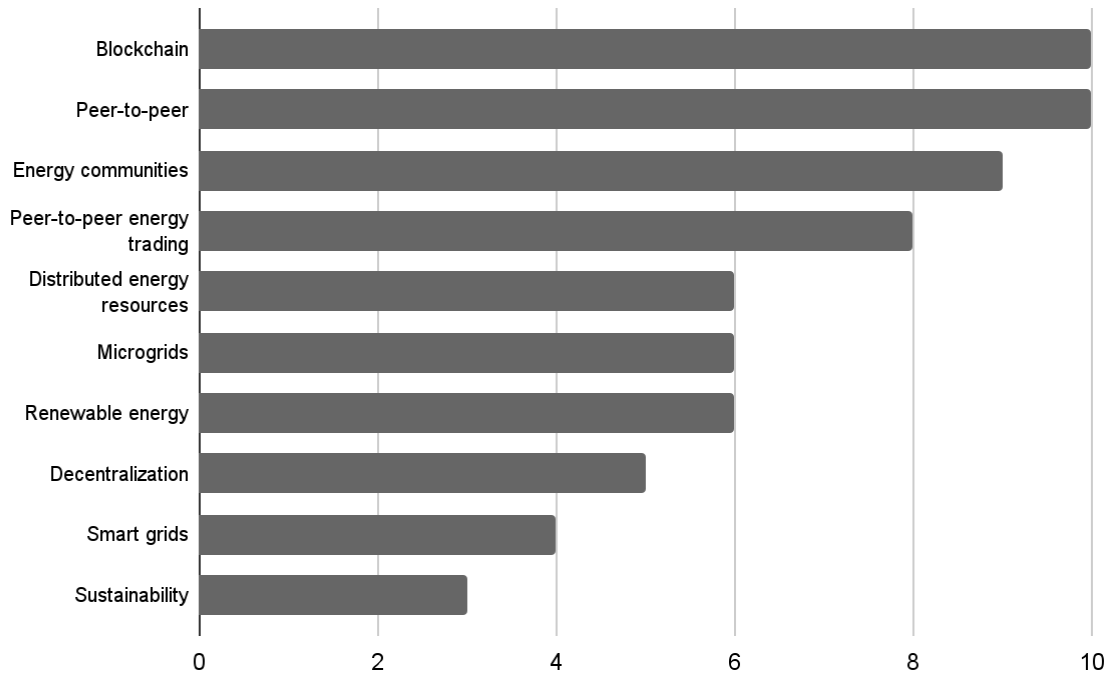
Borges et al. (2022)	D1	International EU-based survey	BCT
Ma et al. (2024)	D2	Bibliometric study	BCT
Siksnelyte-Butkiene et al. (2023)	D4	SLR	Business model overview
Song et al. (2022)	D7	SLR	Transactive energy markets overview
Wolsink (2024)	D12	International interview with experts	Future and conceptualisations of SG
Diaz Valdivia (2023)	D13	Document analysis – whitepapers	BCT
D’Alpaos and Andreolli (2020)	D15	SLR	ESS
Höhne and Tiberius (2020)	D16	Experts – delphi study	BCT future scenarios
Wu et al. (2023)	D22	SLR	Technology for LEC

Wu et al. (2021)	D24	SLR	Technology for Energy Internet
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Delving into the topics explored within the literature, 10 out of 24 articles concentrate on the technological dimensions of P2PET. Wu et al. (2023) in article D22, and Wu et al. (2021) in article D24, provide comprehensive overviews of the emerging technologies within the energy sector, analysing their applications, limitations, and potential opportunities. Notably, energy storage systems (ESS) emerge as a focal point within the examined articles. Ecker et al. (2018) in article D21 investigate the perspectives and preferences of P2PET users in Germany regarding ESS adoption, scrutinising tendencies for autonomy and autarky in trading behaviour vis-à-vis ESS purchasing decisions. D'Alpaos and Andreolli (2020) in D15 explore investment trends in storage systems and renewable energy sources.

Furthermore, among the technology-oriented articles, 6 articles specifically study and address BCT. Borges et al. (2022) in D1, and Schneiders and Shipworth (2021) in D10 examine legal considerations surrounding BCT, with Borges et al. (2022) delving into social perspectives and Schneiders and Shipworth (2021) exploring legal frameworks in the United Kingdom. Fell et al. (2019) in D11 assess consumer demand for BCT-enabled P2PET in the UK context. Ma et al. (2024) in D2 conduct a bibliometric study on BCT in the energy sector, highlighting P2PET as a key application area. And Diaz Valdivia (2023) in D13 and Höhne and Tiberius (2020) in D16 investigate BCT's role in the energy transition, identifying P2PET as a significant opportunity for the application of this technology. Additionally, an analysis of keywords uncovered that besides the keywords directly linked to the elements of the search string, BCT belongs to the most cited keywords from the whole sample. The frequent occurrence of BCT as a keyword further confirms the high research interest focused on this technology. Figure 4 summarises the 10 most frequently cited keywords identified in the body of literature.

Figure 4 - Most cited keywords



Among the subject topics of the reviewed articles, pricing strategy and business models within the context of P2PET present another notable group of articles. Groh et al. (2022) in article D3 conduct a pricing strategy study utilising experiments with SOLshare and Microgrids (MG), offering insights into localised pricing dynamics in the context of Bangladesh. Globally, Siksnyte-Butkiene et al. (2023) in D4 and Song et al. (2022) in D7 shed light on diverse business models and transactive energy mechanisms, coupled with SWOT analyses to assess their strengths, weaknesses, opportunities, and threats. Further enhancing the understanding of business models, Karami and Madlener (2022) in D6 focus on user preferences through surveys, elucidating the nuances of business model selection and implementation within the P2PET landscape in Germany.

Multiple of the studied articles focus on exploring the diverse roles and preferences of actors in P2PET situated in different geographic contexts. Bonfert (2024) in article D5 studies the roles of different actors within Local Energy Communities (LEC) across four P2PET projects based in Europe, offering insights into the dynamics of community engagement and participation. Similarly, there are three articles in the sample that study the user preferences in the context of Germany. Among these, Karami and Madlener (2022) in D6 focus on user preferences relating them to the different P2PET business models. Hahnel et al. (2020) in D14 also study the trading preferences of potential users of P2PET via a simulated scenario. Ecker et al. (2018) in article D21 investigate the perspectives and preferences of P2PET users regarding ESS adoption. Ableitner et al. (2020) in D17 study the behaviour of prosumers and P2PET users in Switzerland. Li et al. (2022) in D9 study the preferences of the potential P2PET users in South Korea. There are two articles

studying the users preferences and behaviour in Bangladesh. In these articles, Kirchhoff and Strunz (2019) in D19 and Khan (2019) in D23 shed light on the drivers and barriers to P2PET adoption offering insights into localised adoption dynamics and challenges. Furthermore, Singh et al. (2018) in D20 employ ethnographic research interventions and surveys to explore peer-to-peer returns in off-grid energy sharing dynamics in India.

Several of the studied articles present exploratory examinations of specific national contexts in regards to P2PET. Wang et al. (2020) in D8 conduct an economic assessment of P2PET policy frameworks, complemented by a case study analysis, shedding light on the economic implications and feasibility of P2PET adoption within the Chinese context. Li et al. (2022) in D9 conducts an explorative study of users preferences in South Korea to assess the potential interest in future P2PET adoption. Paudel and Marungsri (2024) in D18 evaluate strategies for community-based P2PET models providing insights regarding potential implementation of P2PET initiatives into the Thai context.

Even though simulation and modelling as a method of data collection is one of the exclusion factors of the search strategy, there are multiple ways these tools can be employed. Thus, it is worth mentioning that 5 of the studied articles employ hypothetical or simulated scenarios in their methodology. Paudel and Marungsri (2024) in D18 employ simulation methods using real-life data to evaluate different strategies for community-based P2PET models. As they reason in the article, the lack of experience with P2PET in the Thai context would not allow for an applied exploratory study. Since the P2PET market is also still limited in South Korea, Li et al. (2022) in D9 use a hypothetical case which is used to study user preferences according to possible scenarios. A similar approach is taken by Hahnel et al. (2020) in D14 in the context of Germany, to study the potential for new users to join the P2PET market. Höhne and Tiberius (2020) in D16 and Wolsink (2024) in D12 study the expert outlook on the future scenarios and thus use hypothetical cases to conceptualise the potential occurrences. The use of simulation and hypothetical cases in all four listed articles does not substitute collection of empirical data. And since all the above-presented cases make empirical inferences about the context for P2PET adoption or its future perspectives, they are included in the studied sample.

Notably, 7 of the 24 articles employ document analysis to approach their study of P2PET. Since the research focuses of these articles are already presented above, a brief enumeration of these follows: Ma et al. (2023) in article D2 conduct a bibliometric study, while D'Alpaos and Andreolli (2020) in D15, Wu et al. (2021) in D22, Wu et al. (2021) in D24, Siksnyte-Butkiene et al. (2023) in D4, Song et al. (2022) in D7 Khan (2019) in D23 all conduct a systematic literature review. Furthermore, Diaz Valdivia (2023) in D13 conducted a document analysis of whitepapers published by P2PET projects. The high number of document-oriented analyses in the sample is considered to be a limitation regarding the type of conclusions this thesis can derive at. While it weakens the possibility to directly report on the occurrences of energy justice and injustice situations studied in real-life configurations, it opens the access to a large variety and diversity of

P2PET configurations. These articles can also reveal further academic context and connections that exist between the articles and P2PET configurations since some of them are directly studied in the literature as well as featured in the included reviews. Furthermore, considering that none of the reviews explicitly focuses on the questions of justice confirms the existing knowledge gap in this area of research.

The objective of this chapter is to introduce the articles included in the review highlighting some of the characteristics that delineate their differences and similarities within the sample. However, it also uncovers a methodological limitation consisting of the divide among the articles. As pointed out by Xiao & Watson (2017), a heterogeneous body of literature can pose a challenge for conducting extending reviews since the heterogeneity limits the theory-building potential of the review. Since the above-introduced differences in geographical focus and research method largely overlap, a distinctive group of articles that lacks both focused geographical localisation and analysis of primary empirical data emerges from the sample. However, with the exception of roles and preferences of P2PET actors, and national context exploration topic areas, the localised and non-localised articles are relatively equally distributed among the topic areas. Given this distribution across subject topics and taking into consideration that the meta-narrative analysis is employed, the heterogeneity of articles should not pose a significant limitation to the thesis.

## **Chapter 4: P2PET configurations**

This is the first of the three analytical chapters elaborated in this thesis. To maintain the systematic nature of the review and minimise the risk of selectively choosing reported evidence, all articles contributing to the respective findings are cited. However, for the sake of readability, in-text referencing is avoided, and instead, brief tags introduced in Chapter 3 are employed to denote the articles. This practice is further upheld in the rest of the thesis.

In this chapter, the findings of the thematic analysis regarding the P2PET configurations are presented as identified within the body of analysed articles. The emergent themes that have surfaced through the analysis are organised into four distinct sections encapsulating the key facets of P2PET configurations considering both their social and technical dimensions. The thematic sections described in this chapter are the following: Models and Conceptualizations of P2PET, Infrastructure and Scale of P2PET Configurations, Participants and Actors, and The Contextual Factors Influencing the Adoption of P2PET Initiatives. By delineating these themes, the aim is to provide a comprehensive understanding of the multifaceted dynamics inherent in P2PET configurations, offering insights into the evolving landscape of decentralised energy trading.

### **4.1 Models and Conceptualisations of P2PET Configurations**

During the course of the analysis, it became apparent that creating a categorisation of the P2PET configurations is a complex endeavour. As stated in D13, it is a common practice for the providers of P2PET services to leverage their technological and organisational solutions to the practice of

energy trading. Consequently, the descriptions of the P2PET configurations studied in the literature commonly entail project-specific terminology which often makes it impossible to directly compare configurations. However, it is still possible to draw parallels and categorise the configurations based on their general characteristics. Moreover, multiple attempts to categorise the respective P2PET models according to their technological solutions (D4, D7, D14) or business-model characteristics (D6, D18) have been identified in the studied literature. However, due to the diverse focuses of the articles, the overlap of the identified categorisations is incomplete. Therefore, this section provides a compiled categorisation of the P2PET configurations in order to be able to refer to them in a systematic and transparent manner and draw conclusions across the articles.

From the analysis it is apparent that the position of solar power is very important for the conceptualisations of P2PET practice. It has been identified that in the studied articles, solar power is the prominent DER. Consequently, PVs are discussed to be the most widespread means of energy generation in the P2PET configurations. With the exception of D2, all of the studied articles discuss solar power in relation to P2PET. The second DER identified in the articles is the eolic energy (D5, D9, D12, D13, D18, D24), however none of the studied articles further elaborates on the practicalities or discusses the use of this DER in the P2PET scheme. Therefore, all of the models and conceptualisations of P2PET configurations discussed in this thesis, are designed for and targeting solar power.

When describing the organisation and practical functioning of the P2PET configurations, the articles studied through this review approach the matter from various levels of abstraction. While some approach it from a more descriptive position providing a high level of detail about the infrastructure and type of interactions within the configurations, others opt for a more conceptual approach, fully or partially omitting such information. The more conceptual articles include D5, D7, D8, D10, D11, D15, D17, D18, D22 and D24, where little information about the technical specifications of P2PET configurations is included. Terminology-wise, these articles either refer to the configurations as local energy communities (LECs) in D5, local energy markets (LEMs) in D22, transactive energy in D7, or use the term P2PET platforms as an umbrella term without providing detailed specifications of the configurations in question (D8, D10, D11, D15, D17, D18, D24). The following article explains the identified differences between these denominations.

LEMs and LECs represent frameworks wherein various stakeholders, including households, companies, and associations, engage in the production and distribution of energy (D5, D22). The concept of transactive energy is integral to the conceptualisation of such models, highlighting their two-way nature and prosumption orientation and emphasises both vertical and horizontal connections within the grid, illustrating the complexity of energy dynamics in these contexts (D7). While not inherently P2PET models themselves, transactive energy, LEMs, and LECs encompass diverse configurations, with P2PET serving as one potential – and currently the most discussed – solution for energy sharing within these contexts.

Taking a closer look at the P2PET practice, a range of trading models is encompassed in these configurations. Among them full, community-based, and hybrid models are distinguished. In the full model, users engage directly without intermediaries, facilitated by bilateral smart contracts for transactions (D4, D7). This arrangement, also referred to as the organic model in D14, emphasises decentralised negotiation and has been discussed extensively in the literature (D6, D17). Conversely, the community-based P2PET model involves a third-party operator responsible for grid optimization and deal management. The operator is usually algorithm-based and automated. Its role is to secure optimal trading outcomes (D4, D7, D14). Meanwhile, hybrid models offer the flexibility for users to switch and alternate between the above-presented models (D4, D7). The main difference among the above-presented trading models is thus managerial, concerning the level of control the users have over the trading decisions. However, the trading management solutions represent only one of the distinctive characteristics of the studied configurations.

The introduced P2PET trading models can operate upon various designs of physical energy systems. Amongst them, microgrids and P2PET platforms are the most widely discussed designs in the literature. The difference between them lies in their solutions for energy distribution. Microgrid-driven P2PET, commonly referred to in the literature as microgrid (MG) (D3, D12, D13, D14, D19) or nanogrid (D18, D23) is a design describing some small-scale P2PET configurations. The main characteristic of MG is that its users are connected by a distribution network used exclusively to accommodate the P2PET practices (D3, D12, D13, D14, D18, D19, D23). Having their own distribution grid, these configurations can operate in an off-grid setting, but can also be installed to households that already have a connection to a larger grid (D18). In contrast to the MG design, the P2PET conceptualised as a trading platform cannot be operated in off-grid settings. As described in D6, this design does not require for the P2PET provider to own, manage, or directly operate any kind of energy distribution infrastructure as it relies on the grid that already connects the users. The main role of the P2PET as a platform is to facilitate the trading process and manage the transactions. Detailed descriptions of this P2PET conceptualisation can be found in D6 and D9.

When studying the conceptualisations of the P2PET practice, the offered services described in the literature venture beyond trading itself. According to some articles there are multiple services that belong among the conceptualisations of P2PET. These are community ownership models and virtual power plants. Virtual Power Plants (VPPs) are conceptualised as a method to coordinate and optimise the supply and demand of self-generated energy in order to enhance energy efficiency and security within a LEC (D4, D6, D12, D15, D24). Operating akin to traditional power plants, VPPs aggregate the community DERs forming a virtual entity capable of providing various grid services, including creating reserves (D4, D6, D12, D15, D24). The community ownership model represents a shared approach to energy resources, as outlined in D4. In this model, the generation assets are collectively owned by a community. The generated energy is then shared amongst the community members who can benefit from more affordable self-produced energy

while reducing the purchase costs of DERs. As described in D<sub>4</sub>, the application of this model is often motivated by the desire to reduce individual energy costs. Even though these conceptualisations of P<sub>2</sub>PET exist, they are only loosely mentioned and described in the reviewed literature, and therefore are not further elaborated on in this thesis. Nevertheless, they are worthy of a mention since they belong to the P<sub>2</sub>PET panorama.

The aim of this section is to introduce and distinguish the main types of configurations identified in the literature, in order to provide clarity regarding the terminology used and referred to in the thesis. However, the data from the reviewed literature do not allow to establish a distinct typology for P<sub>2</sub>PET configurations. The variances delineated in the literature and described in this section, manifest more as a general set of distinctive characteristics upon which configurations can be constructed. The following sections of this chapter delve deeper into the technological and organisational characteristics of the configurations identified in the reviewed literature.

## **4.2 Infrastructure and Scale of P<sub>2</sub>PET Configurations**

In the examined literature, various physical and technological factors were identified, giving rise to distinct themes. These themes primarily centre on discussions and debates surrounding the trade-offs inherent in potential technological solutions and the constraints imposed by current technologies on the scalability of P<sub>2</sub>PET configurations. In this section, the identified themes regarding infrastructure and scale of the identified configurations are presented.

### **4.2.1 Infrastructure and Technology of P<sub>2</sub>PET Configurations**

From the analysis, multiple themes regarding the infrastructure and technological devices required to establish and operate a P<sub>2</sub>PET configuration emerged. This section introduces these themes organised according to which of the technological components of the P<sub>2</sub>PET configurations they belong to.

In order for the P<sub>2</sub>PET to work, the users need to be connected through a distribution grid. There are two recurring themes present in the articles regarding the distribution grids. The first of them concerns the technical specifications of the grid, while the second concerns access and control over the distribution grid. From the P<sub>2</sub>PET configurations described in the studied articles, direct current (DC) energy grids seem to be a better option for a P<sub>2</sub>P exchange through MG. In D<sub>12</sub>, this statement is reasoned with the explanation that since the PVs typically generate DC energy, MGs using DC can be expected to be the natural option. The validity of this solution is confirmed by a real-life project in Bangladesh studied in D<sub>3</sub>, D<sub>19</sub> and D<sub>23</sub>. The possibility of MGs using the alternating current (AC) energy is also discussed in the literature. Its benefits are emphasised in the context of MGs in industrial use or long-distance energy exchange where DC is not suitable. However, the debate on the use of AC grids in P<sub>2</sub>PET is still only theoretical (D<sub>19</sub>, D<sub>24</sub>). Consequently, this debate uncovers a practical limitation for the scalability of the P<sub>2</sub>PET configurations. The second theme regarding the access and control over the distribution grid is foreshadowed by the difference between MGs and P<sub>2</sub>PET platforms introduced in the previous



section. The theme in question is whether the grid should be owned by the P2PET provider or outsourced. For this discussion the external context of the particular P2PET configurations is key, and for that reason, this theme is further elaborated on in section 4.4.2 of this chapter.

The storage systems are another widely discussed infrastructure-related aspect of the P2PET configurations. Storing energy plays a crucial part in balancing the mismatch between the peaks in generation and demand. Consequently, the articles present three possible technological solutions to go about storing energy. The most discussed are Energy Storage Systems (ESS) (D12, D13, D15, D17, D21, D22, D24), a battery-type storage that prevails as the mostly applied solution. As an alternative to the battery-type ESS, the power-to-gas and power-to-heat technology (D22) and virtual batteries (D6) have been identified. However, all of these solutions are claimed to have a high purchase cost which undermines the affordability of these solutions.

Another essential part of all the P2PET configurations are the smart solutions which play a key role in the management and distribution of resources and transactions. The role of smart technologies such as information and communication technology (ICT) (D12, D13, D24), Internet of Things (IoT) (D12), machine learning and artificial intelligence (AI) (D13, D24) is highly discussed in the literature. Even though the articles generally do not provide detailed enough information about the technologies used in particular configurations, only one configuration has been conclusively identified to not rely on them. It is the case of the configuration documented in D20. The configuration described in this study differs from the rest as the participants in D20 were not connected by a physical grid, but instead relied on their social connections by renting mobile solar-powered devices. Even though this configuration presents an example of P2PET configuration that is not technology-enabled, it is rather an exception in this field.

One of the enabling technologies are smart or bi-directional metres which allow the participants of P2PET configurations to both sell and purchase energy (D4, D9, D18, D23). As stated in D4, the penetration of this technology is increasing, however, as of 2019, the world percentage was only 14% globally with large regional differences. Taking into consideration the identified importance of smart metres for the adoption of current P2PET services, the question of accessibility of the P2PET services in different parts of the world arises. Besides smart metres, there are multiple other smart technologies that are integral to the identified configurations. Furthermore, as already stated, the current and future role of BCT in the energy sector is a widely discussed topic. From the perspective of practical application of BCT into the P2PET configurations, there is a debate on which type of BCT should be used: public, permissioned, or private (D10, D11, D13, D16). Even though the discussion on the implications of this choice is not prominent in the studied articles, it can play a part in the accessibility and performance of the configurations.

#### **4.2.2 Scale of Studied Configurations**

When focusing on the physical characteristics of the P2PET configurations, it can be concluded that in the real-life P2PET projects and pilots covered by the literature, trading occurs in rather small-scale configurations with a maximum of 50 households (D3, D19, D20, D23). These

configurations have been found to be conceptualised as MG projects operating in rural settings with no connection to the national grid. Even though the rural off-grid setting can be coincidental and limiting in regards to the potential number of participants, the question of causality should be examined. On the other hand, as stated in D6, the current studies focusing on pricing strategies, business models, and optimisation methods do focus on development of solutions suitable for large-scale populations of users. And the explorative studies analysed in the review, generally work with large samples coming from densely populated areas (D1, D5, D6, D9, D11, D14, D17, D21). However, according to D4, the MGs as well as the P2PET platform models are inherently geographically restricted. As energy loss increases with the distance it has to cover through the grid, covering long-distance transactions would not be efficient. In conclusion, setting inherent geographical restrictions by adopting the MG model does not need to reflect the demand, but it can also stem from the aim to optimise trading and avoid energy loss. The remaining question therefore is, how the current mismatch between geographical limitations of the configurations and large-scale optimisation and management methods will be bridged and applied in practice.

### **4.3 Participants and Actors**

Having previously discussed the technological aspects of the P2PET configurations, this section delves into the social dimension of the P2PET configurations. The themes presented in this section centre around the type of actors engaged in the P2PET practice, their roles and motivations for joining the configurations. The aim of this section is to explore who the participants of the P2PET configurations are and how the studied literature frames them.

#### **4.3.1 Participants and Providers**

The analysis of social actors of the P2PET configurations across the reviewed literature revealed significant disparities in conceptualizations regarding participant roles. While some articles exclusively identify human actors, including individuals and provider companies, as participants (D20, D23), others extend this classification to encompass smart technologies that actively engage in actions within the configurations, such as aggregators or storage units (D3, D13, D22). Notably, among the sampled articles, D13 adopts the most inclusive stance towards participant delineation, branching out of the core of the P2PET configurations and including the adjacent actors from the energy system. In this study, roles attributed to Distribution Systems Operators (DSOs), retailers, aggregators, a spectrum of end-users spanning households to businesses, as well as producers and prosumers, are included into the list of participants. Consequently, the line between social and technical dimensions becomes increasingly blurred in this regard.

When discussing the role of end-users within P2PET configurations, numerous articles within the reviewed literature acknowledge a notable lack of research on users' preferences and needs, and thus aim to fill in this gap (D6, D9, D14, D17, D21). Even though the bottom-up character of the P2PET configurations is often claimed (D13, D14, D19, D23), from the existing research on end-user participation, three noteworthy cases disproving this claim emerge. Firstly, in D5, the

absence of grassroots initiatives in all four studied configurations is highlighted, resulting in a reported neglect of end-users' preferences and needs. Secondly, D<sub>3</sub> explores users' interactions within MGs and reveals that prosumers generally refrain from actively engaging in energy selling, instead expressing interest in catering their own energy demand and upgrading their storage systems. The study identifies only a minority of active sellers within each MG, with the majority of users primarily purchasing or self-consuming energy. This conclusion is also supported by the third identified case. In D<sub>21</sub> the energy independence of the users rather than the ability to trade is emphasised as the motivation for prosumerism. The identified empirical findings underscore the importance of further research in understanding user behaviours and preferences.

In addition to end-users, providers and operators are key actors extensively discussed in the literature. The literature frequently addresses their positioning relative to end-users and the agendas they pursue. A recurring theme is the debate over whether providers should be public or private entities. Regardless of the geographical location of the project, public actors such as local governments, public councils, or NGOs were most widely discussed for this role. In all four cases studied in D<sub>5</sub>, public actors were involved in hiring and management processes, with one configuration being fully run by public actors. And, according to D<sub>9</sub>, D<sub>11</sub>, and D<sub>18</sub>, a public entity is often perceived as the preferred or envisioned option, with D<sub>1</sub> also considering it acceptable. However, some regional differences regarding the preference and lived experiences with different providers were also identified.

Notably, in configurations operating in the Global South, NGOs are recognized as the driving agents in P<sub>2</sub>PET adoption, as national and local governments often struggle to manage electrification through central grids (D<sub>3</sub>, D<sub>20</sub>). Conversely, D<sub>1</sub>'s survey revealed a preference for private providers among people in European countries, considering them neutral actors. However, D<sub>1</sub> and D<sub>12</sub> also highlighted distrust towards private providers and concerns regarding fair treatment. In configurations studied in D<sub>3</sub>, D<sub>19</sub>, D<sub>23</sub> and D<sub>5</sub>, both private and public actors collaborated as providers and operators of P<sub>2</sub>PET configurations. These findings underscore the complex dynamics surrounding provider and operator roles highlighting the variety of solutions and preferences based on the context and experience of the users. In order to provide a deeper insight into these dynamics, the next section elaborates on the themes regarding the motivations and values of the engaged actors.

### **4.3.2 Values and Motivations**

Across various studies (D<sub>5</sub>, D<sub>6</sub>, D<sub>14</sub>, D<sub>17</sub>, D<sub>20</sub>, D<sub>23</sub>), a spectrum of social values and motivations is identified. Taking into consideration the socio-technical character of said configurations, they are considered to be of significance in shaping the dynamics of these configurations. Thus, this subsection is dedicated to reporting on them. For instance, mutual satisfaction of needs emerges as a prominent value in configurations studied in D<sub>20</sub> and D<sub>23</sub>. In D<sub>20</sub>, the authors delve into the social dynamics influencing choices of returns for energy sharing services. They reveal a preference for returns that equally benefit both parties involved in the exchange. Moreover,

participants display a willingness to adjust payment terms based on trust levels and the closeness of social relationships with their counterparts. This phenomenon, akin to reciprocal altruism, is further explored in D14, where it serves as an initial assumption regarding participants' behaviour in a community MG. However, profit-making emerges as a strong motivation in multiple studies from the reviewed sample (D6, D14, D17, D20, D23). When considered together with the pursuit of autarky discussed in the previous section, the observed behaviour in D20 may be context-specific and potentially non-transferable.

Furthermore, in countries of the Global North, where the level of electrification is generally high, joining a P2PET configuration is one of the available options to secure energy supply. In such a setting, the motivations people have to join such projects range from environmental concerns (D4, D5, D6, D11), to the goal to achieve energy self-sufficiency (D6, D14, D17, D21). Moreover, environmentalism emerges as a pertinent aspect in discussions surrounding P2PET adoption, as evidenced across several examined articles (D6, D11, D12, D13, D19, D21, D23). While in the developed countries, environmental concerns serve as a motivating factor for P2PET adoption, a lesser emphasis on environmental considerations can be found in development contexts (D4, D5, D6, D11). Instead, the focus often shifts towards securing energy access, aligning with findings highlighting P2PET's potential for electrification (D19). Moreover, studies such as D3, D19, and D23 expand on motivations for P2PET adoption in development contexts, attributing uptake to a combination of profit-making opportunities and a lack of alternative options (D3, D19, D23).

## **4.4 The Contextual Factors Influencing the Adoption of P2PET Initiatives**

Besides the social and technological aspects of the P2PET configurations, it is essential to examine the broader context in which these configurations operate. Therefore, this section presents the main themes identified through the analysis in regard to the conditions the configurations are being set in. Furthermore, themes stemming from the dynamics between P2PET configurations and other stakeholders within the energy ecosystem are discussed in this section.

### **4.4.1 Context of P2PET adoption**

The geographical location of P2PET configurations emerges as a critical contextual factor shaping their operation. In countries of the Global South, these configurations offer off-grid energy supply alternatives, alleviating reliance on fossil fuels (D3, D19, D20, D23). Moreover, as highlighted in D3 and D23, climatic conditions significantly influence configuration performance. Authors of D23 note that P2PET MGs in the Global South often operate in adverse climates prone to natural disasters, where large-scale ways of electrification can prove to be complicating both initial construction and long-term maintenance of the infrastructure. On the other hand, in countries of Global North P2PET platforms are more widely used, since the presence of a reliable central grid allows them to operate without having to construct a distribution infrastructure on their own (D9, D11, D18). Furthermore, having their base demand covered, the adoption motivations of the

P2PET actors from the infrastructurally rich areas tend to be more diverse and value-oriented (D4, D5, D6, D11, D14, D17, D21).

In addition to regional differences, political context also significantly shapes P2PET configurations. As discussed in D4 and D5, the increasing energy demand, coupled with rising energy prices, serve as drivers for people to seek alternative energy sources, with DERs and P2PET configurations emerging as increasingly popular options. In response, political entities worldwide are incentivising this transition through legislative measures. For instance, the EU has enacted directives pertaining to innovative energy management systems (D5), while similar efforts to adapt legal frameworks are observed in China (D8), South Korea (D9), and Thailand (D18). However, since the outcomes of these initiatives vary significantly, the current state of national and regional legal frameworks will be discussed in the next chapter.

#### **4.4.2 Relation between P2PET Configurations and Other Actors**

As aforementioned in the section on Infrastructure and Technology of P2PET Configurations, there is a debate revolving around the distribution infrastructure encompassed by P2PET configurations. As outlined in D6, the P2PET configurations may not necessarily require their own physical infrastructure to deliver services. However, even when they do, they still maintain a complex network of relationships, thus cooperation of multiple stakeholders is considered a key prerequisite for a well-functioning P2PET configuration (D13, D21, D22, D24). Since the P2PET configurations are still relatively new to the energy sector, these relationships raise queries about the practical capacities and level of control the P2PET providers can exercise over the configurations.

The relationship between P2PET configurations and the central, typically national, grid emerges as a significant theme from the analysis. Some configurations identified in the literature exhibit minimal or no reliance on the central grid (D3, D19, D23), while others are fully integrated with it, such as the configurations using the P2PET platform design described in D6. The studied configurations situated in rural settings or within developing nations often lack the opportunity to connect to a central grid. This increases the vulnerability of these configurations who need to rely on self-production or explore alternative backup sources such as diesel generators or kerosene (D3, D19, D20, D23). However, as noted in D23, such alternatives may not suffice to meet all essential needs, such as mobile phone charging. Conversely, in instances where a connection exists, the central grid can serve as a backup for participants in the P2PET service, providing support during periods of high demand (D9, D11, D18). However, while the integration with larger grids can enhance the stability of the service, it also heightens its dependence on third parties, typically large-scale power supply companies or DSOs (D9, D11). This integration is commonly observed in configurations within urban areas of developed countries, where the P2PET configurations are more intricately linked with the central grid (D9, D11).

Understanding the dynamics among the relevant stakeholders is especially relevant for the “platform” model of P2PET configurations (D4, D22). One recurring trade-off identified in the

literature arises from the interconnection of P2PET configurations with larger grids, particularly regarding the ownership and management of generation and distribution infrastructure. Based on the studied sample, typically, end-users own and oversee the generation infrastructure featured in P2PET services. However, it is a common practice that the distribution infrastructure of P2PET configurations located in infrastructurally rich areas belongs to a third-party DSO (D4, D5, D6). While this practice enhances the affordability of P2PET projects by eliminating distribution infrastructure costs for participants (D4, D15), it also heightens project dependency on a third-party to facilitate the distribution (D5). From the studied literature it can be concluded that with the uptake of P2PET practice, the hierarchies among the current stakeholders in the energy sector will change, and new stakeholders will appear (D5, D6, D8, D22). And since many countries privatised their generation and distribution infrastructure (D5), competition between national grid providers, P2PET projects, and other stakeholders is to be expected (D3, D5, D23).

A second recurring theme concerns the claims about independence of P2PET configurations. Even though, in theory, the P2PET configurations can work independently from the rest of the market, some of the reviewed articles claim that in practice there will always be interconnections between the two. The above-described physical interconnections of the energy infrastructure are only one of the manifestations of this interconnection. Market price fluctuations present another, less tangible but still very present interconnection that needs to be accounted for when claiming that P2PET supply and pricing can work independently from the central energy markets (D4, D18). Furthermore, these relations and dynamics between actors can change and become relevant even for configurations that are not in contact with any other energy grid or market yet. And as discussed in D23, in the case of Bangladesh, the currently operating off-grid MGs are legally considered to be a form of “pre-electricity”. As of now, the practical meaning of this status remains an open question. However, the author assumes that practical implications are likely to appear once the interconnection between the MGs and the national grid happens (D23). A similar phenomenon is described in D12. The authors of the article point out the tendency for legal documents and policies to commonly refer to DERs as an “additional to base-load generation capacity” (p. 2) insinuating the position of renewable energies in the energy sector.

The cases presented in this section demonstrate the intertwined relations of the P2PET configurations, uncovering their dependencies even on seemingly external actors and stakeholders. Together with the themes regarding the conceptualisations, technological solutions and involved actors, the themes regarding the context of P2PET adoption conclude the chapter reporting on the findings of the thematic analysis on P2PET configurations. The thematic analysis of the P2PET configurations reveals a lack of definitive categorisation, underscoring their susceptibility to contextual variations, actor motivations, and individual infrastructural characteristics. Even though the complexity of the configurations complicates the identification of causal relationships between configurations and their impact on energy justice, this analysis opens the terrain for a deeper and systematic inquiry about this topic. The following chapter

delves into a comprehensive examination of the impacts of P2PET the reviewed literature reports on in relation to energy justice.

## **Chapter 5: Energy Justice Aspects of P2PET**

In this chapter, the results of the thematic analysis regarding the energy justice aspects identified in the analysed articles is presented. The findings are structured in accordance with the three-tenet analytical framework used to code and analyse the data. In order to maintain the internal logic of the analytical framework, the order of the thematic blocks is the following. The energy justice research lens adopted for this section of analysis builds on the work of Jenkins et al. (2016). Hence, following the reasoning of the authors, firstly, it is important to study the distributional characteristics of the configurations, to understand what is the physical setting in which the question of justice is studied. Therefore, the first section of this chapter presents the findings pertaining to distributional justice. Secondly, the authors of the framework suggest inspecting the themes regarding the users of the configurations. This step is taken to uncover the potential injustices that the users experience, and potentially identify groups and individuals that are being privileged or made vulnerable by the lived setting. This question is tackled by the second section of this chapter that elaborates on the themes of justice as recognition. The third and last step of the framework is to analyse the procedural justice within the configurations. This tenet of justice focuses on the rights and responsibilities the actors involved in P2PET have and the legal and civil processes they can use to claim them. The themes identified in this matter are presented in the third section of this chapter.

Since each of the justice tenets studies different aspects of the P2PET configurations, the evidence that was searched for and the aspects that were analysed vary across the sections of this chapter. For that reason each of the sections follows a different structure for reporting the findings. The structure with its internal logic is thus always presented in the beginning of each section.

### **5.1 Distributional justice**

The distributional tenet of the energy justice framework aims to uncover the potential barriers and limitations the P2PET configurations pose to their users either during the use or before adoption. Thus the evidence that was searched for covers the questions of accessibility, availability, and affordability of the prerequisite infrastructure, P2PET services, and energy itself. However, since clearly articulated analytical themes emerged from the analysis, the coding structure is not used for the reporting. Instead, the analytical themes are used to present the findings of the analysis. The themes presented in this section include: Inequality of Access, Allocation of Energy and Services through Blockchain, Opening Access in Underserved Areas, Active Participation as a Condition for Access, and Affordability and Costs of Infrastructure.

### 5.1.1 Inequality of Access

The first theme identified through the analysis concerns the inequality of access. The notion of access that is referred to in this section encompasses the technological availability and affordability of joining the P2PET configuration. But it also entails the individual accessibility of services, such as the opportunities the users have to buy and sell energy within their configuration.

Scrutinising the access conditions when joining a P2PET configuration, two themes regarding the accessibility and availability were identified. Firstly, the socio-economic factors influencing the affinity of potential users to adopt P2PET were analysed. And as the analysis uncovered, except for their economic status, factors such as age or level of education generally do not decisively influence the adoption of P2PET. However, there is a consensus that individuals with higher economic standing are more inclined to adopt P2PET practices (D9, D11, D14, D17). Consequently, economic status serves as a prerequisite condition for what is termed the "frontrunner paradox," discussed in studies like D5 and D11. Communities benefiting from regional technological and socio-economic progress tend to possess greater disposable income and lower risk aversion, making them more receptive to innovation and its benefits. Consequently, these early adopters enjoy advantageous conditions for further innovation, outpacing less privileged regions and communities, which "may inherently limit the transferability of energy innovation to other local contexts" (D5, p. 6). Moreover, aside from influencing the geographical transferability of P2PET, the frontrunner paradox may exacerbate inequalities within a community. For instance, as discussed in D11, the predominance of wealthier participants can impact trading prices and the adoptability of P2PET across various social groups.

The second identified theme concerns the availability of P2PET services. A notable barrier hindering the adoption of P2PET, and, consequently making the service unavailable for certain groups of people, are the legal restrictions limiting the installation of DERs. Such cases are discussed in D4, D5, D6, D8, and D9. For instance, it was discovered that individuals residing in historically protected houses faced challenges in obtaining permits for the installation of DERs due to monument protection regulations (D5, D6). Additionally, variations in the legal recognition of P2PET and the associated engagement conditions were identified across different countries, which may deter individuals from participating in such initiatives (D5, D8, D9). The legal intricacies surrounding P2PET will be further examined in section 5.3, particularly from the perspective of procedural justice.

Furthermore, it was identified that the question of access is not only relevant when entering the configuration, as systemic inequalities also emerge from studying the practice of selling and buying energy in the configurations. Among some platforms and services a differentiated user-hierarchy determining their accessibility to the trading services has been observed. Platforms studied in D6, D13 and D18 categorise participants based on their strength and relative position within the trading scheme, benefiting members with the highest share the most. Another



mechanism of unequal access to services was identified in D<sub>3</sub>. In the examined configuration, the geographical positioning of users within the grid influences their ability to sell energy to others. One of the standard aims of the algorithms managing the trading within the P<sub>2</sub>PET configurations is to reduce energy loss during transportation. A reported effect of applying this condition in the examined configuration is that participants with more connections and shorter distances to other households have better access to selling surplus energy and generating profit (D<sub>3</sub>). Beyond geographical proximity, social connections among participants can also impact access to P<sub>2</sub>PET services. For instance, a case of configuration reflecting the social structures into the organisation of P<sub>2</sub>PET interactions is documented in D<sub>20</sub>.

### **5.1.2 Allocation of Energy and Services through Blockchain**

Another theme identified through the literature concerns the allocation of energy and services by the P<sub>2</sub>PET configurations studied in the reviewed literature. One of the recurring aspects of this theme is the question of how to reliably allocate energy in the grid. This question is relevant considering the mismatch between the peaks of the DER production, and the demand time of the households. To address these concerns, optimisation of energy allocation is a major topic amongst the distributional justice aspects identified in the articles (D<sub>12</sub>, D<sub>13</sub>, D<sub>17</sub>, D<sub>18</sub>, D<sub>19</sub>, D<sub>21</sub>, D<sub>22</sub>, D<sub>23</sub>, D<sub>24</sub>). The optimising potential of P<sub>2</sub>PET is generally attributed to the use of the BCT and the smart technologies enabling the management of P<sub>2</sub>PET transactions (D<sub>2</sub>, D<sub>4</sub>, D<sub>10</sub>, D<sub>11</sub>, D<sub>12</sub>, D<sub>13</sub>, D<sub>14</sub>, D<sub>16</sub>, D<sub>22</sub>, D<sub>23</sub>, D<sub>24</sub>). Even though no empirical evidence supporting these claims was identified in the literature, two applications of BCT with the potential to increase the accessibility of P<sub>2</sub>PET were found. These applications concern communities using shared assets such as PV installed on a shared rooftop (D<sub>10</sub>) and asset non-owners who use P<sub>2</sub>PET only to source energy as documented in D<sub>19</sub> and D<sub>23</sub>. In both cases, the decentralised management through BCT is used to include these otherwise non-eligible participants into the trading scheme.

However, drawbacks of these technological solutions are also discussed in the literature. Firstly, the BCT applications have so far only been tested on small-scale configurations (D<sub>1</sub>). This leaves an open question regarding the scalability of BCT-enabled P<sub>2</sub>PET, as there are concerns about its performance with bigger data loads (D<sub>1</sub>, D<sub>24</sub>). Secondly, it was found that the P<sub>2</sub>PET participants do face the trade-offs caused by balancing individual and community needs through the energy redistribution mechanisms embedded in the management algorithms (D<sub>17</sub>, D<sub>18</sub>, D<sub>22</sub>, D<sub>23</sub>). And, thirdly, there are concerns in relation to trust in the autonomous systems and their ability to achieve a fair distribution of energy, resources and revenues (D<sub>1</sub>). According to D<sub>5</sub>, there is evidence that grids that focus on supply stability do so at the cost of deprioritising energy democracy and even access (D<sub>5</sub>).

### **5.1.3 Opening Access in Underserved Areas**

As already discussed in the previous chapter, the analysis uncovered that the motivations behind joining a P<sub>2</sub>PET configuration vary in the countries of Global North and Global South. In contrast

to the projects operating in Global North, in countries of the Global South, the adoption of P2PET projects is demand-driven. As suggested in the literature, for many infrastructurally underserved regions, P2PET presents an opportunity as an affordable and reliable electrification method (D<sub>3</sub>, D<sub>17</sub>, D<sub>19</sub>, D<sub>20</sub>, D<sub>22</sub>, D<sub>23</sub>). Some of the studied articles directly attribute the uptake of P2PET in the developing countries to the lack of other options, due to the lack of energy infrastructure and services or their insufficient reliability (D<sub>3</sub>, D<sub>19</sub>, D<sub>23</sub>). Moreover, the authors of D<sub>3</sub> state that in infrastructurally underserved regions the preference to join a P2PET service prevails even when a national grid is available.

In the development context, the option to access renewable energy facilitated by P2PET configurations offers a reliable and safer power source for essential household appliances, as revealed in D<sub>23</sub>. The reliability of the P2PET microgrids in Global South is also documented in the literature. In D<sub>3</sub> and D<sub>23</sub>, the authors evidence the increasing use of energetically demanding appliances such as refrigerators or fans that require a stable energy supply. Even though they note that this process is still relatively slow. Furthermore, in D<sub>23</sub>, multiple pieces of anecdotal evidence are gathered and presented in order to demonstrate the different aspects of life that are being positively affected by the adoption of P2PET in rural Bangladesh. These accounts range from safer indoor-lighting improving the study conditions for low income children to increased quality of medical care thanks to wider penetration of small devices such as nebulisers. Consequently, as the authors of these articles claim, P2PET adoption plays a pivotal role in mitigating the repercussions of energy poverty in underserved areas lacking infrastructure.

#### **5.1.4 Active Participation as a Condition for Access**

As assumed by the theoretical literature on sharing economy, the analysis supported the claim that the P2PET practice signifies a notable shift in responsibility toward participants and end-users. As a consequence of that, a change in the attitudes and skill sets are invested upon the participants of the P2PET configurations. Among the new requirements imposed on the participants, the analysis uncovered that this transition requires both technical and administrative skills as well as interest in the technology from the participants (D<sub>5</sub>, D<sub>6</sub>). Moreover, it demands a more proactive engagement and a departure from conventional consumer habits. Among the identified shifts, load-shifting emerges as a prominent practice (D<sub>10</sub>, D<sub>17</sub>). To optimise the synchronisation between energy supply and demand, countries like Switzerland offer financial incentives. These encourage the shift of energy consumption towards the peak hours of renewable energy production. Participants are thus incentivised to adjust their consumption behaviours — shifting loads — to leverage renewable energy and secure favourable P2PET prices (D<sub>17</sub>, D<sub>24</sub>). Even though the increased management burden for the participants of P2PET configurations is recognised in the literature, the practical impacts of these adjustments remain largely unexplored in the existing literature.

Furthermore, active participation in the P2PET practice was identified as a newly required responsibility of the users threatening the functioning of these configurations (D<sub>1</sub>, D<sub>3</sub>, D<sub>5</sub>, D<sub>13</sub>,

D19, D21). As already mentioned, energy autarky emerges as a significant motivator for end-users to engage in such configurations. This inclination combined with aversion to trading is observed across participants from both the Global North and the Global South, irrespective of their options for alternative energy access (D3, D4, D6, D14, D19, D21, D23). Consequently, due to the inherent variability in renewable energy generation, P2PET configurations may encounter intermittent shortages in energy supply stemming from a lack of willing sellers (D14). Achieving stability in P2PET configurations necessitates behavioural changes among participants, often entailing sacrifices for communal benefit. Some projects are endeavouring to address this challenge by fostering altruistic behaviour, such as setting prices below standard expectations or donating energy to less privileged participants (D6, D14, D20). Even though the authors of D6 bring up this opportunity, they also recognise that among the projects examined by them, none actively prioritise support for the economically disadvantaged. Additionally, findings from D5 indicate that certain P2PET services tend to promote their offerings at the expense of overlooking energy poverty concerns.

### **5.1.5 Affordability and Costs of Infrastructure**

Concerning the affordability of joining a P2PET configuration, the articles under review predominantly address infrastructure costs. Analysis revealed three primary factors favouring the affordability of P2PET compared to standalone DERs production. Firstly, despite the decreasing prices of PV systems, which enhance affordability for the general public (D4, D5, D15, D17), the initial investment remains a barrier for various social groups across different contexts (D5, D6, D11, D14, D23). In the reviewed literature, P2PET projects have been identified that offer leasing arrangements to alleviate the initial costs of PV purchase and mitigate this hurdle (D6, D11, D19, D23). Secondly, the expense associated with ESS, enabling prosumers to store and utilise energy beyond production peaks, remains very high (D4, D15, D17, D21) and no incentives aimed at enhancing ESS affordability have been identified in the literature. Thirdly, feed-in tariffs (FiTs), subsidies serving to compensate prosumers for surplus energy injected into the main grid, are generally low and on a decreasing trend (D3, D6, D8, D14, D15, D17). Consequently, participation in a P2PET configuration enables prosumers to capitalise on diverse load profiles and generation assets within the community, selling and purchasing energy at advantageous rates, and, thereby, reducing their energy expenses (D4, D6, D8, D9, D13, D15, D17, D19).

However, both D4 and D11 underscore a potential drawback of P2PET adoption, suggesting that while advantageous for participants, it may unjustly shift costs onto non-adopters. The authors contend that non-users, by abstaining from P2PET participation and technology investment, could face higher energy costs. This claim concerns the P2PET models within which a trading community utilises the distribution infrastructure supplied by a third-party DSO. In such a scenario, P2PET users reduce their energy expenses via energy exchange, reducing their reliance on supply from the main grid. Conversely, non-adopters, reliant solely on supply from the main grid, bear a larger share of maintaining its costs (D11). In that light, the authors of D4 warn against

the P2PET participants practically exploiting the distribution infrastructure of the main grid to distribute the P2P-traded energy without being obliged to participate in the distribution costs.

## **5.2 Justice as Recognition**

The second tenet of the energy justice framework pertains to justice as recognition, emphasising the examination of the groups and individuals who participate in the P2PET practice. The aim of this tenet is to identify potential systemic discriminations and vulnerable groups, as well as instances of exploitation and other detrimental behaviours within these configurations. This section presents the findings regarding the acknowledgment of actors involved in the studied P2PET configurations, as depicted in the literature under review. The focus of the investigation was to identify instances of injustice, shaping the organisational structure of this section accordingly. Thus, it is divided into three key aspects representing potential breaches of recognition justice: Cultural Domination, Disrespect, and Non-recognition.

### **5.2.1 Cultural Domination**

When searching for instances of cultural domination in the reviewed literature, two cases have been identified as bearing signs of cultural domination. The first case introduced in this section concerns a P2PET configuration that includes the possibility of choosing non-monetary returns for energy provision highlighting the predominant monetary compensation system. The second case examines the role of peer pressure on the public acceptance of P2PET.

Although the business models vary across the articles, all the identified configurations conceptualise P2PET as an energy exchange for compensation, which is, in the majority of cases, monetary. However, D20 challenges this monetary conceptualisation by introducing in-kind and non-monetary payments as potential compensation for energy services. In this study, conducted in an off-grid rural setting in India, households are not physically connected to a grid. Instead, a designated individual – the peer-provider – within the community oversees a DER charging station and a set of appliances available for rent to the community. The exchange follows rules set by the peer-provider and agreed on within the community. With no predefined trading mechanism, trading practices emerge organically from participants' lived experiences, reflecting their preferences and needs. Consequently, the paradigm of monetary compensation is challenged by alternative forms such as barter and intangibles. Moreover, this study (D20) illuminates the relationship between social structures, relationships, and the method of compensation selection, revealing a departure from the Western-dominant paradigm of a fixed, monetary compensation system.

The topic of public acceptance of P2PET is explored in depth in articles D3, D5, D6, and D23. The authors of D4 and D23 highlight that despite its potential benefits, the lack of public acceptance of P2PET and the associated technologies remains a significant barrier to broader adoption in many countries. The underlying causes of this barrier and strategies to overcome it are extensively discussed. Despite that, several studies have identified signs of peer pressure influencing the

adoption of P2PET (D4, D5, D6, D17, D20). The motives for such a behaviour range from the desire to share positive experiences with family and friends (D6, D17) to directed peer-based marketing strategies used by the provider services such as referral bonuses (D6). Moreover, the perceived positive environmental impact of self-producing and sharing energy is frequently emphasised, with environmentalism often cited as a motivation for P2PET adoption (D4, D5, D6, D11). Considering the traction environmental topics have recently gained in the public discussion, social cohesion, conformity, and a broader cultural shift towards a green transition can all be discussed as playing a role in the uptake of P2PET practice.

### **5.2.2 Disrespect**

Regarding the phenomenon of disrespect, the analysis primarily identified isolated cases rather than systemic patterns. Indications of a lack of respect and strained relationships among the actors involved in the configurations were noted in multiple articles (D1, D5, D12, D17, D19, D20, D23), however in none of the articles the issues were discussed in depth. Therefore, a concise summary of these occurrences is provided: instances of authorities showing disrespect towards P2PET participants or providers (D5, D8, D12), instances of peers displaying disrespect towards authorities (D5, D8, D12, D23), and instances of mistrust among peers regarding their trading decisions (D1, D19).

The sole described instance of direct disrespect from authorities towards P2PET actors is detailed in D8. The authors of this article primarily discuss the implications and economic viability of China's No. 1901 document, a policy regulating P2PET conditions. However, they also provide a description of how the public authorities address reported issues regarding the policy. The aim of said policy is to legally outline the rules for P2PET in China. Thus, participant eligibility, subsidy rates, and fee calculation methods, including state-paid subsidies are established in it. However, the article highlights that these policy points are ambiguously formulated, leaving potential providers and users uncertain about the required trading conditions. Moreover, the authors argue that the policy formulation contradicts the interests of future P2PET actors. Despite complaints and requests for clarification, no official response addressing these concerns was provided. Consequently, the authors claim, the service providers felt deceived by ambiguous fee calculations, leading to uncertainty and controversy, discouraging participation in P2PET projects. The lack of government response led the authors of D8 to speculate that the ambiguity may have been deliberate. Therefore, the act of disrespect in this case is attributed to the authorities' failure to respond appropriately to legitimate concerns when due.

### **5.2.3 Non-recognition**

The theme of non-recognition is present in multiple of the studied articles. Similarly to the theme of disrespect, there are signs and mentions that indicate underlying issues, however, due to the lack of in-depth discussion, only a brief summary of these is provided: lack of recognition of users' perspective in research (D1, D11, D14, D17) and lack of data and research in the countries of Global

South (D3, D23). Nonetheless, one more widely covered case concerning non-recognition was identified in the literature and thus is elaborated on.

The occurrence was identified in D12, where a conflict emerges between natural, technical, and social scientists regarding their perspectives on the institutional features of P2PET. When questioned about the potential of the distributed energy system technologies – those enabling the P2PET – to produce institutional changes to the current system, the social scientists were supportive of the claim. By doing so, as stated in the article, they supported the idea that technologies can shape and be shaped by their social and institutional context. In contrast to that, the natural and technical scientists were rather dismissive of such claims. The authors suggest that this division reflects a broader academic bias against acknowledging social components in technology and innovation studies. Consequently, natural and technical scientists may misinterpret the institutional changes induced by P2PET.

### **5.3 Procedural Justice**

The analysis concerning the procedural tenet of energy justice, focuses on studying the respective roles the engaged actors have in the decision-making processes concerning the adoption and functioning of the studied P2PET configurations. Stemming from these roles, subsequently, the rights and responsibilities the actors claim and should obey are discussed. Even though the framework treats the roles, rights and responsibilities as three distinctive facets of procedural justice, in practice it is complicated to separate the latter. Therefore, the findings presented in this section are divided into two blocks. The first one presents the themes identified regarding the recognition of different actors within the decision-making process. The second section overviews the respective rights and responsibilities that the actors of the P2PET configurations have.

#### **5.3.1 Recognition in Decision-Making**

One of the themes identified regarding the decision-making process concerns the recognition of P2PET configurations within the energy sector. Given its novelty, P2PET projects often encounter challenges in obtaining official recognition, thereby hindering advocacy efforts for user rights (D5, D17, D22). Recognition of the P2PET model is typically contingent on national policies, both legislatively (D9, D10, D18, D23) and in implementation (D8). Bangladesh serves as an illustrative case where MGs are viewed as a precursor to formal electricity provision, raising questions about their integration into the national grid (D23). Conversely, the case of China highlights practical non-recognition issues within P2PET policies, as discussed in the previous section.

Since prosumerism, inherent in the P2PET practice, affects the roles of the participants of the P2PET configurations, another theme identified in the studied literature is the current lack of legal protection of P2PET participants. The participants of P2PET configurations not only consume but also produce energy, taking on responsibilities such as investing in generation facilities, maintenance, and trading decisions. Acknowledging this shift, efforts have been made to afford prosumers legal protection and integrate them into decision-making processes.

However, as evidenced in various studies (D5, D10, D12, D13), this step poses practical challenges. Considering that P2PET participants do not have the same resources as companies, the authors of D10 raise the question whether it is even safe to impose such obligations on users (D10, p.7). To address these concerns, several articles emphasise the necessity of legal regulatory changes to solidify the role of P2PET configurations and prosumers in energy production (D4, D6, D10, D11, D12, D16, D23).

As discussed in D10, the EU is active in addressing the issue of legal recognition and protection of P2PET users. In order to unite and protect the participants of such configurations, it mandates the formation of legal entities like cooperatives or limited liability partnerships (LLPs). This approach is identified to be reiterated in multiple articles from the reviewed literature (D10, D12, D21). Furthermore, a greater recognition of users agency and needs is discussed as a potential strategy to encourage people to assume the additional responsibilities and become prosumers (D3, D4) which can play a key role in the energy transition (D5, D14). Conversely, the current inadequate policies and regulatory frameworks (D4, D5, D10, D12, D13) along with administrative complexities (D4, D23) pose significant barriers to P2PET adoption. In the absence of standardised decision-making practices, the ways in which various actors and stakeholders engage in decision-making processes are intricate. In this regard, advocacy and governmental coordination at both vertical and horizontal levels are deemed essential for idea exchange and mitigating regional inequalities (D5). Furthermore, multiple articles suggest that the interaction between prospective P2PET participants and local government can prove to be effective in this matter. Despite limited legislative authority and given their proximity to citizens, local governments wield executive and representative powers to advocate for customer protection (D4, D5, D11).

Another pertinent theme revolves around the management of shared assets, as evidenced in studies of P2PET practices in India and Bangladesh (D19, D20). These studies document challenges stemming from shared asset management, including low levels of trust among prosumers and instances of unofficial co-ownership without legal recourse. As documented in D19, the respondents expressed the interest to self-impose community-specific rules in order to ensure a fair use of the service and appropriate handling of the infrastructure. However, given the predefined lack of hierarchy in the configuration, they were unable to establish an authority to enforce them. Similar concerns about shared asset management were highlighted in D20. In contrast to the configuration studied in D19, the participants of D20 were empowered to establish and enforce their own rules which they eventually did. Nevertheless, despite being given a relatively free hand in the decision-making process, the participants of D20 still considered the shared management of assets and suboptimal solution. Another issue emerged from the literature concerns the cases of unofficial co-ownership of generation assets reported in D19. According to the article, official ownership of essential infrastructure such as PV panels and smart metres could only be claimed by one user. However, due to the unaffordability of the initial investment for some individuals, they opted to collectively purchase the infrastructure. As a result, without a legal

claim to ownership, practical co-owners find themselves with limited authority in decision-making processes.

A recurring theme in decision-making processes is the legal recognition of smart contracts. Even though the literature highlights numerous benefits of using this technology (D<sub>1</sub>, D<sub>2</sub>, D<sub>10</sub>, D<sub>13</sub>, D<sub>22</sub>, D<sub>24</sub>), concerns persist regarding their legality (D<sub>1</sub>, D<sub>10</sub>). The main questions are how to translate them into the legal order, and who would be responsible for potential mistakes (D<sub>1</sub>). Furthermore, the authors of article D<sub>1</sub> claim that people are concerned about the automated decision-making through which smart contracts operate since they lack transparency in the process (D<sub>1</sub>). Generally, it was found out, that individuals value having control over their trading decisions (D<sub>1</sub>, D<sub>3</sub>, D<sub>6</sub>, D<sub>7</sub>, D<sub>8</sub>, D<sub>9</sub>, D<sub>11</sub>, D<sub>12</sub>, D<sub>13</sub>, D<sub>14</sub>, D<sub>17</sub>, D<sub>18</sub>, D<sub>19</sub>, D<sub>20</sub>, D<sub>21</sub>, D<sub>23</sub>, D<sub>24</sub>), valuing autonomy over their energy and assets (D<sub>1</sub>, D<sub>21</sub>, D<sub>22</sub>). Consequently, automated trading mechanisms evoke concerns about relinquishing this control (D<sub>1</sub>), and open space for a debate over the advantages and drawbacks of automated trading.

While it was found out that automated trading simplifies the P<sub>2</sub>PET practice for end-users (D<sub>1</sub>, D<sub>14</sub>, D<sub>17</sub>, D<sub>21</sub>), it falls short in fully predicting their preferences compounded by individual differences in decision-making strategies that complicate automation (D<sub>7</sub>, D<sub>14</sub>). It was also found that when trading manually, people tend to be more conservative and risk-averse, which can lead to constraining the market and not achieving a desired supply-demand balance (D<sub>3</sub>). By partially giving up the decision-making power, automated decision-making can prevent this issue and optimise the trading decisions (D<sub>1</sub>, D<sub>7</sub>, D<sub>13</sub>, D<sub>24</sub>). The central theme emerging from this debate pertains to the function of automated trading mechanisms within the P<sub>2</sub>PET framework. While sources such as D<sub>9</sub> and D<sub>18</sub> advocate for the P<sub>2</sub>PET platform to serve solely as an intermediary, bringing peers together, others, like D<sub>24</sub>, suggest it can also play a coordinating role, facilitating and overseeing connections among peers.

### **5.3.2 Rights and Responsibilities**

Since the recognition of actors in decision-making directly impacts the rights and obligations of the actors engaged with the P<sub>2</sub>PET, the themes discussed in this section are closely intertwined with those introduced in the previous one. Therefore, one of the prominent themes identified through the analysis builds on the question of the changing roles of prosumers, both within P<sub>2</sub>PET configurations and society at large, prompting inquiry into who shapes and formalises these roles. In the studied literature, there is a consensus that the rights and responsibilities of prosumers should be codified in the legal system in order to protect the users of P<sub>2</sub>PET services (D<sub>10</sub>, D<sub>11</sub>, D<sub>13</sub>). However, as consumer roles evolve, discrepancies and potential legal gaps emerge (D<sub>10</sub>). And as documented in the literature, national governments, typically tasked with this codification, may exploit legal loopholes to serve various interests (D<sub>5</sub>, D<sub>8</sub>). While supra and international organisations like the EU can exert influence, their recommendations lack direct binding force, leaving member states and local governments accountable for adopting P<sub>2</sub>PET models and engaging communities in energy production (D<sub>5</sub>).



Regarding the rights and responsibilities of P2PET service users, individuals possess the right to trade energy in alignment with their preferences, yet are under no obligation to offer their energy for sale. Furthermore, as discussed in D3, in configurations where generation assets are privately owned, there are no incentives or responsibilities for users to invest in the maintenance or scaling of their infrastructure. Consequently, the service's stability hinges largely on users' willingness to sell, potentially conflicting with the identified desire for autarky and self-sufficiency (D3, D4, D6, D14, D19, D21, D23).

A second theme concerning the rights and responsibilities within the P2PET configurations stems from the fact that BCT operates independently of national or regional authorities (D1, p.1079). This lack of legal affiliation to any national or regional system poses challenges in regulation of this technology and consequently establishing enforceable sets of rights and responsibilities for the configurations that implement BCT in their models. An illustrative case from the literature revolves around the applicability of the General Data Protection Regulation (GDPR) to BCT-enabled transactions, commonly utilised in P2PET platforms. The personal data of users on BCT are pseudonymised, and since a link exists between the data and the transactions, the connections are, in theory, traceable. However, the GDPR mandates full anonymisation of data in EU countries, which could cause issues for the P2PET projects (D1, D5, D10). Presently, the compliance of BCT with European law remains uncertain, although it is anticipated to be addressed in the future (D1). Nonetheless, this ambiguity presents a legal risk for P2PET platforms operating within the EU region that opt to utilise BCT.

As delineated in this chapter, P2PET configurations and practices exert both positive and negative impacts on the landscape of energy justice, while also prompting inquiries regarding future implementation, utilisation, and engagement with other energy and political stakeholders. As previously underscored in the concluding section of the preceding chapter, a comprehensive categorization of diverse P2PET configurations remains unattainable due to the multitude of configuration-specific variables, encompassing contextual factors, types of actors involved, and technological solutions employed. Nonetheless, the insights provided in this chapter facilitate the examination and evaluation of how various aspects of these configurations influence energy justice. Consequently, the subsequent chapter is dedicated to establishing these connections and addressing the research questions at hand.

## **Chapter 6: Themes and Relationships between P2PET and Energy Justice**

As already explained in the methods section, the aim of this chapter is to answer the research questions formulated for this thesis and lay the groundwork for further discussion. To do so, a thematic synthesis drawing from the previous analytical stages is conducted. Furthermore, to critically assess the reviewed literature's positionality within the academic landscape, ensuring a

balanced and informed viewpoint, the coded data from prior analytical stages are revisited providing the base for a meta-narrative analysis of the reviewed sample. The aim of this step is to identify patterns that could help to deepen the understanding of the reviewed articles. Therefore, positioning of the reviewed articles within the academic context, adoption of specific research lenses or theoretical concepts is studied to facilitate a more comprehensive discussion. The initial section of this chapter outlines the findings of the meta-narrative analysis, succeeded by the thematic synthesis.

## **6.1 Meta-narrative analysis**

Upon revisiting the coded data, the aim was to discern overarching narratives uniting the reviewed articles or delineating distinct positional perspectives within the sample. This process shed light on several aspects that contextualised the previous findings of the thematic analysis. Additionally, the absence of certain discussions and topics merits acknowledgment, offering insights into the composition and focus of the sample. Both types of findings are presented in this section.

The growing research attention towards P2PET practices and configurations over the past decade is not only evident in the composition of the sample but also emerges as a recurring theme throughout the reviewed literature (D<sub>2</sub>, D<sub>4</sub>, D<sub>6</sub>). One of the repeatedly identified notions is that despite this increased attention, a lack of applied evidence (D<sub>6</sub>) and a noticeable research gap, particularly concerning end-users' perspectives and needs (D<sub>1</sub>, D<sub>11</sub>, D<sub>14</sub>, D<sub>17</sub>). There is a stream of the reviewed literature that aims at filling in this gap. However, the majority of the reviewed articles is not inherently human-centred, as it is rather driven by the technological aspects of innovation, optimisation and management mechanisms, or contextual setting. As discussed in chapter 3 of this thesis, 6 of the reviewed articles primarily delve into BCT, consistently emphasising the optimisation potential of the technology for P2PET practices (D<sub>1</sub>, D<sub>2</sub>, D<sub>10</sub>, D<sub>11</sub>, D<sub>12</sub>, D<sub>16</sub>). And multiple other papers also underscore BCT's significance for P2PET attributing the energy allocation and managerial achievements of P2PET to the technology (D<sub>4</sub>, D<sub>6</sub>, D<sub>9</sub>, D<sub>17</sub>, D<sub>18</sub>, D<sub>22</sub>, D<sub>24</sub>). The technological dimensions of the practice emerge as significant, with the articles heavily emphasising the role of the technical solutions on the organisation and management of the practice.

Even though the technological transformative aspects of P2PET are widely discussed in the literature, the social aspects as the shaping factors for these changes are not given enough attention. Multiple of the articles underscore the transformative potential of P2PET for the social dimension. The core of what is considered to be impacted are the trading paradigms, exchange mechanisms, access dynamics (D<sub>2</sub>, D<sub>5</sub>, D<sub>13</sub>, D<sub>16</sub>, D<sub>22</sub>), and the traditional roles and interactions among grid participants (D<sub>5</sub>, D<sub>6</sub>, D<sub>13</sub>, D<sub>15</sub>). However, the study of the social causes and mechanisms in this transformation is rather elusive in the literature. Out of the 24 articles, only 2 articles openly discuss the socio-technical character of P2PET. According to the authors of D<sub>7</sub>, P2PET is closely associated with the concept of transactive energy, heralding a shift towards a

cyber-physical society deemed "inevitable and promising" (p.2). The socio-technical nature of power grids under these innovative paradigms is also explored in D12, conceptualising the power grid as an ecosystem with dynamic socio-technical systems. The above-presented findings are in line with the theme identified in D12, namely the underestimation of the social dimension on the institutional characteristics of P2PET.

Another prominent thread running through many of the examined articles is the type of relation the authors establish between P2PET and the sharing economy concept. They often portray P2PET as a practical application of the theoretical sharing economy concept (D6, D7, D10, D17, D22). Some even juxtapose P2PET with other sharing economy platforms like Airbnb and Uber to underscore the nuanced societal and economic implications these configurations can bring (D7, D17). Mindful of the debate about the social implications brought about by the platforms of the sharing economy, authors in D10 briefly deliberate on the fairness of new obligations stemming from the P2PET model for its participants. Furthermore, in D6 and D7, sharing economy is used to back the claims regarding the purported potential of P2PET in broadening market access and mitigating market uncertainty, themes recurrent across multiple articles (D3, D10, D12, D15, D17). While the theoretical link between the sharing economy and P2PET appears to be rooted deep in the literature, evidence-oriented studies explicitly elaborating on parallels remain scarce. Thus, it is inferred that while there are preconceived notions about how the sharing economy applies to the conceptual and practical functioning of P2PET configurations, detailed discussions are lacking.

In relation to the discussion of the previous paragraph, another identified aspect worthy of a mention is the discussion regarding the organisational and relational structures underpinning P2PET. While the majority of the reviewed literature aligns on P2PET's decentralised nature, the absence of in-depth discourse prompts the view that this characterisation is more of a working assumption than an analytical conclusion. This perspective is based on the insights of one of the reviewed articles, which delves into expert opinions on governance conceptualisations of P2PET practice. In D12, expert views on classifying P2PET practice range from hierarchical to polycentric and decentralised governance models. In addition, distinguishing between polycentric and decentralised models can prove challenging, as evidenced by articles like D3, D19, and D23. These articles highlight that the roles in the studied configurations are diversified with some people acting mainly as producers and others mainly purchasing. The varied roles within the configurations and production centred around a few participants would rather suggest a polycentric organisation. Despite this, these articles still consider the studied configurations to be decentralised.

In summary, the analysis reveals recurring assumptions regarding the conceptualization, operational dynamics, and transformative impacts of P2PET configurations. These assumptions often centre on an exaggerated emphasis on the technological dimensions of these configurations and a steadfast adherence to an idealised conceptual framework of the practice. Consequently,

there appears to be a sense of idealisation surrounding the concept, with authors presuming positive effects without accounting for the highly contextual and variable nature of P2PET configurations, which encompass diverse actors, contexts, and configurations. Such complexity introduces numerous confounding factors that preclude a straightforward attribution of positive effects to the practice. Moreover, the lack of political and ideological positioning and discourse within the analysed sample further underscores the need for a more nuanced understanding of P2PET's broader socio-economic implications. This deficiency is particularly conspicuous in articles that reference the sharing economy concept without providing substantive discussion or contextualisation within broader sociological or economic frameworks.

## **6.2 Thematic synthesis**

In this section the thematic synthesis of the two aspects of thematic analysis is conducted and the research sub-questions are responded to. To do so, the insights from the thematic and meta-narrative analysis are used. Since the aim of this section is to answer the set of research questions, this section is divided into four parts, each of them elaborating on the findings of a corresponding sub-question. The questions addressed in this section are as follows:

SQ1: What processes and practices affecting energy justice are enabled by the P2PET?

SQ2: How do the directly engaged actors of the P2PET shape the identified processes and practices?

SQ3: How do the different parts of the physical infrastructure and energy services of P2PET shape the identified processes and practices?

SQ4: Which external conditions affect the performance of the P2PET configuration in terms of energy justice?

### **6.2.1 The Role of P2PET Processes and Practices on Energy Justice**

This section synthesises the main themes concerning the processes and practices of the P2PET configurations identified in the literature. The aim is to respond to the first sub-question of the thesis, which goes as follows: What processes and practices affecting energy justice are enabled by the P2PET?

As identified through the analysis, the landscape of P2PET practices embodies a diverse array of configurations, challenging simplistic categorization and reflecting the multifaceted nature of this new type of energy exchange. Within the P2PET configurations, various trading models emerge, each allocating decision-making power differently among participants. Furthermore, with the newfound agency of decentralised energy prosumption, concerns over user protection have been identified as a major theme across the studied literature concerning the state of energy justice. This theme is particularly important since it has been found out that the participants of

the configurations – end-users of the P2PET services – are forced by the nature of the practice to adopt new tasks and responsibilities.

The debate over imposing obligations on users underscores the need for legal regulatory changes to ensure fairness and accountability within P2PET frameworks. With the active engagement of P2PET participants in production and trading of energy, numerous responsibilities shift towards the participants. These include both the financial burden of infrastructure acquisition and management, and the routine involvement in managing the trading. Considering that P2PET participants do not have the same resources as energy companies established in the energy sector, the authors of D10 express their concerns regarding the fair treatment of prosumers. To address these concerns, several articles emphasise the current lack of legal protection the prosumers face, and the necessity of legal regulatory changes to solidify the role of P2PET configurations and prosumers in energy production (D4, D6, D10, D11, D12, D16, D23).

Furthermore, the change in the trading practice also introduces other implications further changing the requirements and routine tasks for the participants. Consequently, the unknown terrain of the new activities brings various challenges that may also influence energy justice in particular contexts. Active involvement in P2PET introduces new responsibilities, potentially disadvantageous to those unable to trade during peak hours (D1, D3, D5, D13, D19, D21). Entry into these practices demands not only technical and administrative skills but also a departure from traditional consumer habits, with load-shifting emerging as a prominent adaptation (D10, D17). Meanwhile, the evolution of P2PET introduces novel organisational paradigms, particularly regarding shared asset management, as observed in studies from Bangladesh and India (D19, D20). Despite the renewable nature of the energy traded, P2PET perpetuates commodification patterns of the fossil fuels, with profit-driven exchange being one of the motivating factors for adoption. Public acceptance remains a significant barrier, with peer pressure and marketing strategies influencing adoption (D4, D5, D6, D17, D20). The authors of D4 and D11 caution against potential threats to energy justice, suggesting that while advantageous for participants, it may unjustly shift costs onto non-adopters, such as the costs for distribution services in central grids being shifted towards non-adopters.

### **6.2.2 How the Actors of P2PET Influence Energy Justice in the Configurations**

The themes synthesised in this section concern the actors of the P2PET configurations identified in the literature. The aim of this section is to respond to the second sub-question of the thesis, which goes as follows: How do the directly engaged actors of the P2PET shape the identified processes and practices?

The main energy justice concern regarding the implications of the technology used in P2PET configurations questions the socio-technical hierarchy within configurations. The examination of social actors within P2PET configurations across the literature uncovers significant disparities in

conceptualizations regarding participant roles. While some articles narrowly identify human actors, including individuals and provider companies, others broaden this classification to include smart technologies actively engaging within configurations, such as aggregators or storage units (D20, D23). However, the analysis reveals a tendency to neglect the social dimension of configurations when considering decision-making and institutional aspects of innovation. Despite the presentation of P2PET as a decentralised energy access method, with participants setting prices for mutual benefit, manual trading is often supplanted by automated algorithms for grid stability and optimal functioning (D1, D7, D13, D24). On one hand, automated decision-making is advocated to prevent instability and optimise trading decisions, but on the other it is recognised that it cannot fully cater for individual needs and preferences. Thus, while automated trading decisions can optimise the performance of the grid, it comes at the cost of relinquishing some decision-making power, diminishing the decentralised and personalisable nature of the practice. Consequently, the energy justice debate surrounding automated trading mechanisms should focus on the role of P2PET platforms in the trading practice emphasising the trade-offs the participants face between securing access and representation in decision-making.

Furthermore, an overall lack of integrating P2PET participants into decision-making processes was identified as another important theme within the studied literature. Participants often have limited voice and are excluded from configuration design processes (D5, D10, D12, D13). The literature acknowledges a dearth of research on users' preferences and needs, aiming to address this gap (D6, D9, D14, D17, D21). Despite claims of a bottom-up character in P2PET configurations, cases emerge where participants do not shape formal structures but influence practice based on their motivations and values. Motivations such as mutual satisfaction of needs or profit-making can influence trading practices, potentially leading to price fluctuations and intermittent energy shortages. Additionally, social connections among participants can impact access to P2PET services, with configurations sometimes reflecting social structures. Positive discrimination, where participants trade more favourably with close connections, is documented, often enabled by configurations assuming altruistic behaviour, although not always realised in practice (D6, D14, D20). Thus the effects the P2PET practice can cause on energy justice are often highly reliant on the social standards and intentions of the participants of particular configurations.

Furthermore, cases have been identified that illustrate a notable distinction between the formally assigned and lived impact the participants have of the P2PET configurations. While individuals may not actively influence the formal structure of configurations, they do shape their practical implementation. In multiple configurations, prosumers display limited interest in trading, and put emphasis on their own pursuit of energy independence within the configuration. Furthermore, in the development context, the literature suggests that rather than valuing the trading ability of prosumerism and fostering community exchange, P2PET services may serve primarily as affordable electrification. These instances underscore the adaptive nature of individuals, who tailor the service to their preferences over time, gradually altering its original

objectives. Thus, the lack of formal inclusion of end-participants in the decision-making processes does not eliminate their ability to shape the configurations, but it does make it less predictable.

### **6.2.3 The Role of P2PET Technology and Infrastructure on Producing Effects on Energy Justice**

This section presents the synthesis of the main themes concerning the technological and infrastructural aspects of the P2PET configurations identified in the literature. By doing so, the third sub-question of the thesis is responded to. The question addressed in this section goes as follows: How do the different parts of the physical infrastructure and energy services of P2PET shape the identified processes and practices?

As detailed in D13, providers of P2PET services often tailor their technological and organisational solutions to fit the nuances of energy trading practices. Consequently, the descriptions of P2PET configurations found in the literature often include project-specific terminology, making direct comparisons challenging. Many articles use the term "P2PET platforms" as a broad descriptor without delving into detailed specifications of the configurations in question (D8, D10, D11, D15, D17, D18, D24). This lack of in-depth exploration of technological aspects can complicate drawing conclusions. However, despite this limitation, certain technology and infrastructure-related patterns affecting energy justice have been identified.

Among the studied themes, the distinct approaches to energy distribution identified between MGs and P2PET platforms emerge as the most prevalent. The P2PET platforms typically lack their own infrastructure, relying instead on central grids and other stakeholders. While this technical solution can decrease costs of the service, making it more affordable for the end-users, this integration with larger grids increases dependency on third parties, such as large-scale power supply companies or DSOs (D9, D11). This dependency is particularly observable in configurations within urban areas of developed countries, where P2PET setups are intricately intertwined with central grids (D9, D11). On the other hand, off-grid MGs run an increased risk of intermittent shortages in energy supply rendering their energy access less reliable. Furthermore, it has been found out that while households within MGs are less reliant on external stakeholders like DSOs, they face geographic constraints aimed at minimising energy loss. As a result, users' locations within the grid can significantly impact their trading opportunities, with better-connected individuals enjoying greater advantages.

Another finding is that the ESS emerged as a prominent topic of discussion in the literature, with battery-type storage being the predominant solution (D12, D13, D15, D17, D21, D22, D24). However, while the presence of ESS enhances grid stability, its affordability remains a pressing concern. The high cost of ESS presents a significant barrier to adoption, limiting users' ability to invest in infrastructure that could balance production and demand peaks. Thus, the ability to reliably access self-produced energy is dependent on the financial means of the participants.

Furthermore, some of the themes already discussed in the previous sections also do have close ties to the technological solutions of the configurations, and, therefore, are also briefly introduced in relation to this research question. Firstly, smart technologies play a crucial role in optimising energy allocation within P2PET configurations, with BCT and smart algorithms facilitating transaction management (D2, D4, D10, D11, D12, D13, D14, D16, D22, D23, D24). However, these technologies also introduce trade-offs, particularly concerning individual and community needs. Concerns regarding trust in autonomous systems and their ability to achieve fair energy distribution are prevalent (D1, D5). Moreover, issues regarding the legality of smart technologies further complicate matters. Smart contracts, for instance, raise questions about their translation into the legal order and liability for potential errors (D1). Moreover, the autonomous nature of BCT which was identified to be crucial for the functioning of the configurations, operating outside traditional legal frameworks, presents challenges in establishing enforceable rights and responsibilities (D1). An illustrative case involves the discussion regarding the applicability of GDPR to BCT-enabled transactions, commonly used in P2PET platforms.

#### **6.2.4 How External Conditions Shape the Impact of P2PET on Energy Justice**

The themes synthesised in this section cover the context and external conditions in which P2PET configurations operate. The aim of this section is to respond to the fourth sub-question of the thesis, which is the following: Which external conditions affect the performance of the P2PET configuration in terms of energy justice?

Firstly, it was found out that the geographical context significantly influences the operation and impact of P2PET configurations, with notable differences between the Global North and the Global South. In countries of the Global South, P2PET configurations provide off-grid energy supply alternatives, reducing reliance on fossil fuels (D3, D19, D20, D23). Conversely, in the Global North, P2PET platforms are more prevalent due to the presence of reliable central grids, eliminating the need for constructing distribution infrastructure (D9, D11, D18). Configurations in rural or developing areas are often off-grid MG setups, lacking access to central grids and relying on self-production or alternative backup sources like diesel generators or kerosene (D3, D19, D20, D23). However, the backup sources may not meet all essential needs, highlighting the importance of P2PET in providing reliable power sources for households, particularly in adverse climates prone to natural disasters (D23).

Furthermore, the varying motivations for joining P2PET projects seem to correlate with the geographical and socio-economic context. In the Global North, motivations range from environmental concerns to achieving energy self-sufficiency (D4, D5, D6, D11, D14, D17, D21). In contrast, adoption in development contexts is driven by profit-making opportunities and a lack of alternatives (D3, D19, D23). Consequently, the possibility of different participant behaviour and trading dynamics should be accounted for when assessing the energy justice impact. Additionally, the "frontrunner paradox" phenomenon described in the literature suggests that communities



benefiting from technological and socio-economic progress are more receptive to innovation. As a consequence of that, the disparities in adoption rates between regions and social groups are expected to increase discriminating against the less privileged (D5, D11).

The political context also influences the energy justice effects of P2PET. National policies play a crucial role in recognizing and integrating P2PET models into existing energy frameworks (D9, D10, D18, D23). However, outcomes vary, with some regions experiencing practical non-recognition issues due to government inaction (D8). As discussed in the previous sections, this leads to concerns regarding participant protection. Financial incentives also often managed by the political representation, such as feed-in tariffs, impact the affordability and accessibility of P2PET configurations, with decreasing subsidies potentially widening the gap between early adopters of DERs and those lagging behind (D3, D6, D8, D14, D15, D17). On the other hand, there are also cases of positive action from countries like Switzerland, which financially incentivise load-shifting to optimise energy supply-demand synchronisation.

### **6.3 The Likelihood of P2PET to Produce Effects on Energy Justice**

The final section of this chapter aims to address the main research question of the thesis which is the following: What factors influence the likelihood of P2PET affecting energy justice? In order to provide a comprehensive answer, the insights from the thematic synthesis and meta-narrative analysis are used, and presented in this section.

The synthesis reveals the diverse landscape of P2PET practices, defying simple categorisation and highlighting the complexity of this emerging energy exchange model. Legal regulatory changes are deemed necessary to ensure fairness and accountability within P2PET frameworks, given the challenges posed by its novelty. Participants must adapt their habits and increase engagement to secure energy supply or profit from sales. However, current legal frameworks are unprepared for P2PET, leading to minimal user protection and limited commitment to energy justice standards. Hence, the novelty of the practice itself is what raises concerns regarding the energy justice in the studied configurations. Furthermore, given the large variety of these configurations and the practices that are encompassed in them, the energy justice outcomes are highly dependent on the particular participants, solutions and settings rather than on the concept or the principles of P2PET itself.

The impact of P2PET on energy justice is largely determined by social standards and participant intentions, despite the formal exclusion of end-users from decision-making processes. Hence, it's crucial to consider varying participant behaviour and trading dynamics when evaluating the impact of energy justice. Moreover, the absence of formal inclusion of end-participants in decision-making processes, as observed in numerous studied configurations, forces participants to navigate the rules and distributional aspects independently, potentially leading to unlawful and unpredictable actions. Moreover, it was noted that trading stands as the sole formal aspect of

P2PET wherein participants have a substantial voice. However, they are discouraged from utilising it in favour of automated trading. While automated trading decisions enhance grid performance, they also erode the decentralised essence of the practice and limit participants' autonomy in trading. This prompts discussions regarding the role of P2PET platforms in trading practices and the trade-offs participants encounter.

Regarding the infrastructure and technologies used in P2PET, BCT was identified as both vital and potentially problematic for P2PET configurations. Since BCT operates outside traditional legal frameworks, it complicates the establishment of enforceable rights and responsibilities. Furthermore, it is also the technology that facilitates another widely discussed feature of P2PET, the smart contracts. The smart contracts are another potentially problematic feature of the configurations since concerns regarding both its legality and public acceptance have been identified. However, the aspect of the P2PET infrastructure identified in this thesis that has the highest potential to produce negative effects on energy justice is the distribution infrastructure. As already discussed, the particular solution of how a configuration has for the distribution infrastructure defines the dependencies of the configuration on other stakeholders, and the positioning of participants within the grid can prove to be discriminatory in determining their access to trading.

From the examined external factors influencing the performance of the P2PET configurations, geographical context emerged as the most prominent one. It was found out that geographical location can significantly influence the modes of P2PET operation as well as its impact. Particular distinction was identified between the Global North and South, emphasising its potential to increase and improve the energy access especially in underserved or hard-to-reach areas. Given the relative affordability of the minimal working product necessary for operation of P2PET, its potential for electrification was identified as the area in which a direct positive impact on energy justice can be produced. Thus, the geographical context presents an important variable in assessing the potential impact of P2PET on energy justice, being most likely to produce direct effects in infrastructurally underserved areas with limited energy access.

In conclusion, the current interest in P2PET, both in academic research and practical implementation, largely revolves around the ideals of the sharing economy and decentralisation as pathways to progress. There's significant trust placed in smart technologies to optimise human behaviour, often viewed as imperfect and potentially detrimental to these configurations. However, an examination of the impact of P2PET configurations on energy justice reveals that the performance and impacts of these configurations varies from case to case, and is dependent on many context-related variables. Hence the findings of the analysis conducted in this thesis emphasises the need for consideration of participant behaviour, and attention to the socio-technical dynamics when assessing the energy justice outcomes of the configurations. Furthermore, it underscores the necessity of addressing the current legal void with appropriate regulatory frameworks. By tackling these complexities, policymakers and stakeholders can work

towards unlocking the full potential of P2PET in fostering equitable energy access and distribution.

## Chapter 7: Discussion

The objective of this thesis is to fill in the current research gap and gain a better understanding of the relationship between P2PET and energy justice. To do so an extending hybrid review with thematic synthesis was conducted in order to address the question of which factors of P2PET have the potential to produce effects on energy justice. Overall the analysis uncovered that the landscape of P2PET configurations embodies a diverse array of configurations, challenging simplistic categorization and reflecting the multifaceted nature of contemporary energy exchange. Despite this variety, it was found out that P2PET configurations and practices can and do produce direct and indirect effects on energy justice, which are described and assessed in the previous chapter. Furthermore, the thematic findings and the meta-narrative study uncovered that besides empirical evidence, the reviewed articles reflect important aspects of the current academic debate on the topic. Hence, the aim of this discussion is to elaborate on these findings and position them within the wider academic debate on social impacts of the sharing economy.

The link between the sharing economy and P2PET made in the theoretical base of this thesis, proved to be valid since it was identified as a dominant lens in the studied literature, so authors do make a direct connection between the P2PET practice and the sharing economy term. However, the relation that can be observed in the reviewed literature tends to focus on assumed benefits and opportunities brought about by the sharing economy concept. These build on the economic interpretation of the concept, underscoring the potential for opening the markets. However, in line with the claims of Jemielniak and Przegalinska (2020) and Schor (2016), a lack of critical position, with little examination of the potential social implications was identified. The lack of critical examination of this aspect further emphasises the research gap stated in the theoretical literature and reiterated in the problem statement of this thesis, underscoring the importance of further research.

Besides the lack of scrutiny in the field of social impacts of the innovation, emphasising the technological aspects of the innovation is another finding uncovered by the analysis that is in line with the theoretical literature that has been engaged with. As pointed out by Schor (2016) in regards to the P2P practices at large, the potential of smart technologies to reshape the social structures and institutions was proved to be valid in the case of P2PET as well. However, the majority of reviewed articles tend to prioritise technological considerations over human or socio-technical interactions. This is evident in discussions surrounding the advantages and disadvantages of automated trading, where optimising the energy system's balance often takes precedence over individual control in decision-making. Yet, ceding decision-making power could erode the decentralised nature of the practice, raising questions about whether algorithm-driven

automation still preserves decentralised management capable of accommodating a diverse array of individual needs, or if it merely decentralises the physical aspects of management.

The authors referenced in the theoretical context of this thesis suggest that while the principles of the sharing economy theoretically promote equity and justice, translating these ideals into practice is often challenging. While a similar sentiment regarding the theoretical principles of the sharing economy was echoed in the literature review, empirical evidence or robust theoretical discussions to substantiate these claims were notably absent. Given the finding that the performance of P2PET is contingent upon specific contextual, social, and technological factors inherent to each configuration, it prompts inquiry into the feasibility of making overarching claims supported by empirical data.

Jemielniak and Przegalinska (2020) argue that sharing platforms neither establish new social networks nor deepen existing community relationships. This assertion remains unverifiable through the current analysis. However, as previously discussed, the functionality of P2PET configurations is heavily influenced by their unique constituents, with insufficient research dedicated to dissecting the social dynamics within these systems. Consequently, making generalisations or drawing definitive conclusions is currently untenable. Nonetheless, the study did unveil that social connections among participants can influence access to P2PET services, sometimes mirroring existing social structures. Thus, the impact of P2PET practices on energy justice often hinges on the social norms and intentions within specific configurations. Furthermore, the assertions put forth by Schor (2016) and Jemielniak and Przegalinska (2020) regarding the shifting of responsibilities towards end-participants and the concerning lack of legal regulations were substantiated by the analysis. However, except for the less economically privileged groups, the study did not uncover specific vulnerable groups within the society that would be discriminated against through the practice. Instead, it was concluded that the exclusion of end-participants from formal decision-making processes and the absence of legal safeguards compel them to navigate distributional aspects independently, potentially leading to illicit and unpredictable behaviours. Furthermore, these dynamics and mechanisms remain largely unexplored, highlighting the imperative for further research and policy action to prevent and mitigate the adverse effects stemming from this scenario.

## Conclusion

P2PET is a novel practice with the potential to reshape energy markets and methods of energy provision. Often portrayed as enablers of a more democratic and just society, P2PET services face emerging evidence that challenges these claims. Despite increased research interest, the social impacts of P2PET, particularly regarding energy justice, remain largely understudied. This thesis aims to fill this gap by exploring the relationship between P2PET and energy justice through an extending systematic literature review with thematic synthesis.

The analysis revealed a diverse landscape of P2PET configurations, reflecting the multifaceted nature of contemporary energy exchange. P2PET configurations can produce both direct and indirect effects on energy justice. Indirectly, reliance on smart technologies to optimise behaviour can undermine social interactions. Direct effects vary by case and depend on geographical, economic, and infrastructural contexts, as well as participant behaviour and socio-technical dynamics. The study also highlighted a lack of legal frameworks protecting P2PET participants, emphasising the need for regulatory interventions. The academic debate positions P2PET within the ideals of the sharing economy and decentralisation as progressive pathways. However, there is a notable lack of empirical evidence supporting these ideals in practice, underscoring the need for robust regulatory frameworks to ensure fairness and accountability in P2PET markets.

The author of this thesis acknowledges the limitations of the systematic literature review method. Among them is the potential publication bias which can result in an inflated perception of the effectiveness or importance of a phenomenon. Furthermore, the exclusion of non-indexed or non-English studies may result in an incomplete picture of the research topic. The complexity of synthesising findings from different methodologies can also introduce subjective biases. Although an analytical framework was used to prepare and analyse the data, the review should still be read critically due to the inherent potential for synthesis bias. Furthermore, limitations of the findings include the variability of technological adoption and regulatory environments across the reviewed configurations, which do not allow to scrutinise the different solutions presented in the literature. Hence, future research should focus on the long-term social impacts of P2PET, emphasising primary empirical data and the variety of configurations within their specific socio-technical contexts.

In conclusion, while P2PET holds promise for innovative energy trading, its potential to enhance energy justice is influenced by various contextual and socio-technical factors. This thesis contributes to the understanding of P2PET's potential and challenges, highlighting the need for comprehensive regulatory frameworks and robust empirical research. Policymakers and stakeholders must focus on the socio-economic impacts and inclusive participation in energy markets to harness P2PET for equitable and sustainable energy futures.

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## Appendix A: Search Strategy

### Selected keywords and search terms

<i>Peer-to-peer</i>	A N D	<i>Local energy network</i>	A N D	<i>Energy trading</i>	A N D	<i>Energy justice</i>	A N D N O T	<i>Simulation and modeling</i>
p2p		microgrid*		Energy trad*		*justice*		model*ing
peer to peer		micro grid*		Energy swap*		*ethic*		simulation



		off W/1 grid		Energy purchas*		Social right*		algorithm*
		local energy network*		Energy sell*		Social preference*		programm ing
		local electricity network*		Energy shar*		Social attitude*		optimi?atio n
		Distributed energy system*		Energy exchang*		Social distributi*		
		Distributed energy network*		Electricity trad*		Social allocate*		
		Distributed energy grid*		Electricity swap*		Social *connecti*		
		Decentrali?ed energy grid*		Electricity purchas*		Social *divi*		
		Decentrali?ed energy system*		Electricity sell*		Social value*		
		Decentrali?ed energy network*		Electricity shar*		Social capital*		
		Distributed electricity system*		Electricity exchang*		Social status		
		Distributed electricity network*		Management of energy supply		Social *securit*		
		Distributed electricity grid*		Management of electricity supply		Wealth		
		Decentrali?ed electricity grid*		Energy demand management		Poverty		
		Decentrali?ed electricity systems		Electricity demand management		Acknowledg* ment		

		Decentralized electricity network		Energy self- consumption		recognition		
				Self- consumption of energy		*fair*		
				Electricity self- consumption		*equit*		
				Self- consumption of electricity		Polic*		
				Collaborative consumption of energy		Legislat*		
				Collaborative consumption of electricity		Legal*		
				Transactive energy		well being		
				Swarm electrification		wellbeing		
				Energy communit*		access*		
						discrimination		
						prestige		
						reputation		
						race		
						gender*		
						feminist*		
						ethnic		
						advoca*		
						marginali*		
						stratif*		

						cross cutting		
						distributional impact*		
						Cultur*		
						socioeconomic		
						Socio economic		
						sociopolitical		
						Socio political		
						*accountab*		

## Search string

Since there are different search rules and syntax in each of the searched databases, search strings are developed for each database separately.

### Scopus:

Search details:

- Retrieved on 6/2/2024
- Database: Scopus
- Searching TIT-ABS-KEY
- Language: limited to English
- Type of document: limited to Article
- Number of results: **121**

TITLE-ABS-KEY ( "peer to peer" OR p2p AND microgrid\* OR "micro grid\*" OR "off W/1 grid" OR "local energy network\*" OR "local electricity network\*" OR ( distributed OR decentrali?ed AND energy OR electricity AND grid OR network\* OR system\*) AND ( energy OR electricity AND trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchang\* ) OR ( "management of" AND "energy supply" OR "electricity supply" ) OR ( energy OR electricity AND "demand management" ) OR ( energy OR electricity W/1 "self consumption" ) OR ( "collaborative consumption of" AND energy OR electricity ) OR "transactive energy" OR "swarm electrification" OR "energy communit\*" AND \*justice OR \*ethic\* OR ( social AND preference OR attitude\* OR right\* OR distributi\* OR allocati\* OR \*connecti\* OR \*divi\* OR \*securit\* ) OR ( social AND value\* OR capital\* OR status ) OR \*equit\* OR \*equal\* OR \*equitab\* OR \*fair\* OR recognition OR acknowledg\*ment OR wealth OR poverty OR polic\* OR legislat\* OR legal\* OR "well being" OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR \*ethic\* OR

\*accountab\* OR “cross cutting” OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginali\* OR socioeconomic OR "socio economic" OR sociopolitical OR "socio political" OR stratif\* OR cultur\* OR "distributional impact\*" AND NOT model\*ing OR simulation\* OR algorithm\* OR programming OR optimi?ation\* ) AND ( LIMIT-TO ( DOCTYPE , "ar" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" )

## Web of Science:

Search details:

- Retrieved on 6/2/2024
- Database: WoS
- Searching: TS
- Language: limited to English
- Type of document: limited to Article
- Number of results: 99

TS=((“peer to peer” OR p2p) AND (microgrid\* OR “micro grid\*” OR “off the grid” OR “off grid” OR “local energy network” OR “local electricity network” OR ((distributed OR decentralised) AND (energy OR electricity) AND (grid OR network OR system))) AND (((energy OR electricity) AND (trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchang\*)) OR (“management of” AND (“energy supply” OR “electricity supply”)) OR ((energy OR electricity) AND “demand management”) OR ((energy OR electricity) Near/1 “self consumption”) OR (“collaborative consumption of” AND (energy OR electricity)) OR “transactive energy” OR “swarm electrification” OR “energy communit\*”) AND (justice OR injustice OR (social AND ( preference OR attitude\* OR right\* OR distributi\* OR allocati\* OR \*connecti\* OR \*divi\* OR \*securit\*)) OR (social AND (value OR capital OR status)) OR \*equit\* OR \*equal\* OR \*equitab\* OR \*fair\* OR recognition OR acknowledg\*ment OR wealth OR poverty OR polic\* OR legislat\* OR legal\* OR "well being" OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR \*ethic\* OR \*accountab\* OR “cross cutting” OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginali\* OR socioeconomic OR "socio economic" OR sociopolitical OR "socio political" OR stratif\* OR cultur\* OR "distributional impact\*"))

## Eligibility criteria

### General filters

**Peer-reviewed academic articles:**

- Only academic articles published in a peer-reviewed journal are eligible for analysis.

**Articles in final stages of publication:**

Articles eligible for analysis must be accepted for publication or already published by a journal. Thus, only articles with the “published” or “in press” status are eligible.

**English:**

Given the language skills of the researcher, articles eligible for analysis must be written in English.

**Accessible online for free with my institutional access:**

Articles eligible for analysis must be accessible online as open access articles or available through the institutional access provided by WUR.

**Analytical eligibility criteria****P2PET focus:**

- Given the focus of the research, the P2PET focus is an inclusion criterion. To include an article based on this criterion both of the following conditions need to be met:
  - The article does explicitly focus on studying the P2P configurations.
  - The P2P configurations that are studied in the article are directly linked to the act of energy trading. This includes configurations that enable, constitute, regulate, or oversee the trading of energy. A broad understanding of the term “trading” is used including sharing, swapping, exchange and similar activities of collaborative energy consumption and management.

**Exclusion of design-oriented articles:**

- Design-oriented articles are excluded from the analysis. As design-oriented are understood articles that do not aim to study the current real-world configurations to gain new knowledge, but rather aim to design, propose, or introduce technical solutions or improvements, optimisation, pricing or business models, frameworks and methods, etc. Given that the aim of this research is to study the empirical configurations, such articles are excluded from analysis.
- To this end, keywords referring to programming, optimisation, simulation, and modeling are used to form the restrictive search element in the search strategy. The reason behind this decision stems from the iterative process which uncovered that most design-oriented articles come from those research fields and activities.

**Description of research and data collection methods:**

- All articles eligible for analysis are required to include a description of research and data collection methods.

**Use of empirical data:**

- Articles eligible for analysis are required to conduct analysis of empirical data (primary and/or secondary). Studies working with simulated, modeled, or estimated data are not included for analysis.

# Appendix B: Logbook

## 29/12/2023 – 4/1/2024 – Search strategy development

### GOAL:

- To describe what articles I want to retrieve through the search and start finding common denominators in the descriptions – will help me start the search strategy development and keep track of the ideas and

### Describing articles that can answer RQs

- **potential keywords:**
  - prosumer and prosumerism, consumer, energy communities, local, supply, management of energy supply, swarm electrification, community self-consumption, transactive energy models, local energy market
  - Peer-to-peer energy trading, peer-to-peer electricity trading, P2P,
  - Renewable energy sources, sustainable energy, energy transition
  - decentralised energy systems, microgrids, micro-grid, smart grid, off-grid, distributed generation, smart local energy, transactive energy
  - Energy trading, electricity markets, energy sharing, energy exchange
  - Attitudes, values, access, actor configuration
  - Buying, selling, consumption
  - Drivers, challenges, empowerment,
  - Trading platform, business model
  - Energy justice, energy policy, energy poverty
- **should focus on the following phases/aspects of P2P energy trading:**
  - descriptions and reviews of user design – all the articles that talk about the intended or observed interactions of the users with the P2PET, I am interested in the comments on the design of the service, disparities between design and real use, reviews about customer interactions
  - reviews by the customers themselves – sociologic panels, public opinions, user experience reviews
  - larger systemic design of the service – who is it for, what are the prerequisites from the people who are going (intended) to use it
    - articles talking about integrations of P2PET into the energy supply chain and energy system of the region
  - articles that focus on social issues such as interactions, social hierarchies, values (example: Singh, 2017, Adams, 2021)
  - SLRs – contains information from various sources, shows patterns that might be leading my research or showing directions – usually contains new perspectives (example: Soto, 2021)
    - Critical reviews could also work well
  - articles that work with the sociotechnical lingo – shows a certain perspective of interaction between social and technical aspects of the service

- articles about energy justice (example: Jenkins, 2018)
- Value network analysis
- **documents to think about whether to include:**
  - **business models of the P2PET services** – I know there are articles that focus on that, but not sure how these would add to my research
    - **pros:**
      - the business design could influence the energy distribution – the design of how to deal with the peak-off peak ratio – when can customers access the energy, when can they sell
      - the design is a deliberate process that is done and that influences the outcome of the service, it is potentially very important and might bring a lot of interesting information to the research
      - it would fit into the:
        - actors – the developers that make decisions do consciously/unconsciously influence the way people access energy
        - processes and practices – decision making process and practices stemming from the design – selling/purchasing
        - external conditions – the fact that all the services need to deal with the peak and off peak ratio, maybe there are some regulations?, maybe there are some customs in the other energy selling businesses (inherited design choices that are influential)
    - **cons:**
      - usually there are no information about the social consequences, therefore probably, I might need to deduce things
      - there are a lot of articles that focus on this aspect of P2PET – would increase the number of retrieved articles immensely
  - **technological solutions** – there are articles that focus on the technology itself – usually it is not relevant for my research – there are some differences between P2P, community exchange and other types of distributed energy market interactions, but it would require a specialised research to talk about the influence on energy justice

## 8/1/2024 – Search strategy development

**Goal:** to decide which concepts are the key concept to address the different aspects of the RQs. It is the initial stage of the columns development.

Earlier, I have screened the articles that I gathered during the preliminary research and that I based my research on. I went through the title, abstract and keywords of all the articles and searched for key concepts. I included the synonyms and the varying written forms (such as use of “-”) when I found some.

I used the concepts and keywords and tried to sort them out into categories to create future search elements and identify blind spots that I still need to cover by adding more keywords.

- **RQ:** What makes it more likely for peer-to-peer energy trading to produce effects on energy justice?
  - **SQ1:** What **processes** and **practices** affecting energy justice are enabled by the P2P energy trading?
  - **SQ2:** How do the directly engaged **actors** of the P2P energy trading shape the identified processes and practices?
  - **SQ3:** Which **external conditions** affect the **performance** of the **P2P energy trading configuration** in terms of energy justice?
- **potential keywords (identified through literature screening):**
  - prosumer and prosumerism, consumer, energy communities, local, supply, management of energy supply, swarm electrification, community self-consumption, transactive energy models, local energy market
  - Peer-to-peer energy trading, peer-to-peer electricity trading, P2P,
  - Renewable energy sources, sustainable energy, energy transition
  - decentralised energy systems, microgrids, micro-grid, smart grid, off-grid, distributed generation, smart local energy, transactive energy
  - Energy trading, electricity markets, energy sharing, energy exchange
  - Attitudes, values, access, actor configuration
  - **Buying, selling, consumption**
  - Drivers, challenges, empowerment,
  - Trading platform, business model
  - Energy justice, energy policy, energy poverty
- **A:** P2P, peer to peer, peer-to-peer
- **B:** energy community, swarm electrification, prosumerism, prosumer, consumer
- **C:** decentralised energy systems, microgrid, micro-grid network, smart grid, off-grid, distributed generation, smart local energy,
- **D:** management of energy supply, self-consumption, transactive energy, collaborative consumption
- **E:** Energy justice, energy policy, energy poverty, social drivers, **challenges, empowerment, access, class, stratification, attitude**, social value, social capital, procedural justice, distributive justice, justice as recognition, **human rights**
- **F:** energy market, energy trading, electricity markets, energy sharing, energy exchange,
- **G:** Renewable energy sources, sustainable energy, energy transition
- **H:** Trading platform, business model

## 9/1/2024 – Search strategy development

**Goal:** Prioritise the search elements and create the search columns.

I am still unsure which search elements are fundamental for my search and which are excessive and would eventually restrict my search way too much. Therefore, I will prioritise them and hopefully find the right balance by trying the different



combinations directly through searching the databases. For the prioritisation, the matrix design from Bramer et al. (2018) will be used.

Specific      →      General

Important  
↓  
Unimportant

A	B	C	D	E	F	G	H
P2P	Energy trading	Energy justice/injustice	Management of energy supply	Prosumerism	Decentralised energy systems	Energy transition	Business model
Peer to peer	Energy sharing	Procedural justice	Self-consumption	Prosumer	Microgrid (network)	Sustainable energy	Trading platform
Peer-to-peer	Energy exchange	Distributive justice	collaborative consumption	Consumer	Micro-grid (network)	Renewable energy sources	
	Energy market	Justice recognition	Transactive energy		Smart grid		
	Electricity market	Energy poverty	Swarm electrification		off-grid		
	Electricity trading	Social value	Energy community		Smart local energy		
	Electricity sharing	Social capital			Distributed generation		
	Electricity exchange	Energy policy					

## 10/1/2024 – Search strategy development

### GOALS:

- To go through the Web of Science search guide and make notes on the syntax and rules for search.
- To go through the search elements again and merge/erase some of them to create a better functioning structure. Write a brief description for the search elements that stay and a brief explanation for why I decide not to use some of

the terms and preliminary elements for the search strategy – needed for transparency of the search process.

Yesterday I tried to do some vague searches in Scopus, and I realised that I have way too many search elements in the columns table so far. Given that a big number of search elements might restrict my search (something I really want to avoid based on the small number of articles retrieved through the test searches), I decided I need to merge some of the elements and/or erase some.

#### OUTPUT OF THE DAY:

- Today I managed to read through the WoS search guide and I found out that the syntax and use of operators varies a lot from those used in Scopus, I will need to pay attention to it while “translating” the search string from one database to another.
- I had a major mental breakthrough regarding the search elements. I merged some and decided not to use others for now, to maintain a less restrictive search and be able to explore the results of the test searches. The idea is to add restrictions during the process, as I don’t know how many articles there are, given that the topic is quite recent.

#### FOR TOMORROW:

- Search for synonyms and check for bias in the search terms.
- Start translating the search elements into search strings and begin the iteration process.

### Search elements revision

A	B	C	D (merged with B)	E	F	G	H
P2P	Energy trading	Energy justice		Prosumerism	Decentralised energy systems	Energy transition	Business model
Peer to peer	Energy sharing	Procedural justice		Prosumer	Microgrid (network)	Sustainable energy	Trading platform
Peer-to-peer	Energy exchange	Distributive justice → social distribution		Consumer	Micro-grid (network)	Renewable energy sources	
	Energy market	Justice as recognition			Smart grid		
	Electricity market	Energy poverty			off-grid		

	Electricity trading	Social value			Smart local energy		
	Electricity sharing	Social capital			Distributed generation		
	Electricity exchange	Energy policy					
	Management of energy supply	Social drivers					
	Self-consumption	injustice					
	collaborative consumption	welfare					
	Transactive energy	access					
	Swarm electrification	discrimination					
	Energy community	wealth					

### Description of current search elements:

- I decided to keep 3 search elements that have been joined to form the elements A, B, and C. Synonyms still need to be added and also the elements need to be checked for bias.
- **A:** The intention is to search for P2P configurations only, therefore a separate element to describe the articles of interest is dedicated to the P2P.
- **B:** The second element brings in the energy trading aspect of the research.
- **C:** The last element consists of the social/justice-related topics that can lead the search towards articles with the required focus. I decided to slightly alter some of the terms to get rid of reduplication with the previous elements that could cause less retrieved articles.

### Explanation for why some elements are merged and some erased:

- **D:** I decided to merge it with element B as both of the elements referred to the interactions with energy, trading and various configurations the P2P interaction can take. To treat the elements separately would probably lead to restricting the search, which is not desirable.
- **E-H:** The terms of these elements were mostly restrictive for the search. Given that the topic is relatively new and my aim is to research the social implications of it (energy justice), I want to start with less restrictive searches and potentially add restrictive elements during the iteration process.

### New keywords added:

- welfare, social distribution, access, poverty, discrimination, injustice, wealth

## 11/1/2024 – Search strategy development

### GOALS:

- Fill in the columns to complete the search elements:
  - Consider overlapping elements
  - Consider bias (add antonyms to balance out)
  - Search synonyms, abbreviations and spelling versions
- Research the use of thesaurus for string development and work with databases
- Start translating the search elements into search strings and begin the iteration process.

### OUTPUT OF THE DAY:

- There are no in-built Thesaurus functions in neither Scopus nor WoS, therefore I started to fill in the synonyms manually today. The take away point of this activity is that there are numerous possibilities and terms that I could use, but the queries in the databases have limited possibilities. Therefore I think that the terms used in the final strategy will still need to be worked on.
- Regarding the overlapping elements in the table, I think I sorted most of them out by keeping the energy-related terms in column B and the socially-focused terms in column C. Regarding the bias, I think it is difficult to balance that out given that the focus of the research is justice – a highly specific semantically loaded concept. When possible, I try to add the antonym to the searched terms (justice/injustice), but sometimes this coupling does not make sense, or there is no direct antonym that could be paired with the term. I have to keep that in mind. Secondly, I came to the conclusion that it might be beneficial for my search strategy to search for minorities and groups that are assumed to struggle with the justice issues based on previous experience from other fields such as racial or ethnic groups. It is also expected that different social classes, genders and ages might experience different situations. However, I am not sure whether this would make my search biased or more specifically targeted.
- I did not manage to start formulating the search string, but I want to do that the first thing tomorrow to be able to test it and base further decisions about the search terms on the practical searches.

### FOR TOMORROW:

- Use wildcards to shrink the number of search terms and to make the columns more easily readable.
- Formulate 1st versions of search strings.

## Filling in the search elements

A	B	C
---	---	---

P2P	Energy trading	Justice
Peer to peer	Power trading	Injustice
Peer-to-peer	Energy swapping	Social rights
	Energy purchasing	Social Equity
	Energy selling	Social Inequity
	Energy sharing	Fairness
	Energy exchange	Unfairness
	Electricity trading	Equitability
	Electricity swapping	Corruption
	Electricity purchasing	Social distribution
	Electricity selling	Social allocation
	Electricity sharing	Social connection
	Electricity exchange	Social disconnection
	Energy market	Social redivision
	Electricity market	Recognition
	Management of energy supply	Social rejection
	Energy demand management	Acknowledgement
	Power supply management	Poverty
	Energy self-consumption	Social value
	Self-consumption of energy	Social capital
	Electricity self-consumption	Policy
	Self-consumption of electricity	Legislative
	Collaborative consumption of energy	Legislation
	Collaborative consumption of electricity	Legal
	Power self-sufficiency	Wealth
	Energy self-sufficiency	Welfare
	Transactive energy	Well-being
	Swarm electrification	Prosperity
	Energy community	Social benefit
		Access

		Discrimination
		Social status
		Prestige
		Social prominence
		Reputation
		Infamy
		Ethics
		Society
		Accountability
		Bias
		Race/racial
		Gender
		Feminist
		Ethnic
		Advocacy
		Marginalisation
		socioeconomic
		sociopolitical
		Stratification
		Minorities
		Culture
		Environment?

- I filled in the synonyms I thought were relevant and also used the Thesaurus antonyms options to balance out biases of some of the terms such as justice. The aim of balancing the bias out was to avoid or diminish the chances of inducing bias to the search. I think that I will still be adding and removing some of the terms, but so far this is the working version of the search elements table.

•  
**Test string 1:** "P2P" OR "peer to peer" OR {peer-to-peer} AND "energy trading" OR "energy exchange" OR "energy sharing" OR "electricity exchange" OR "electricity trading" OR "electricity sharing" OR "energy market" OR "electricity market" AND "social values" OR "justice" OR "injustice" OR "poverty" OR "wealth" OR "welfare" OR "social distribution" OR "access" OR "recognition" OR "discrimination" = **230 articles**

## Thesaurus and SLR

- Neither Scopus nor WoS have Thesaurus incorporated. I need to search the synonyms manually before writing the search string.
- I will use the Merriam-Webster online Thesaurus to search the synonyms.

## 12/1/2024 – Search strategy development

### GOALS:

- Prepare the terms from the search elements for the search string for Scopus.

### Element A:

- “peer to peer”
- “p2p”
- “peer to peer” OR “p2p”

### Element B:

- (energy OR “electricity AND trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchange\* )
- (energy OR electricity AND market)
- (“management of” AND “energy supply” OR “electricity supply”)
- (energy OR electricity AND “demand management”)
- (energy OR electricity W/1 “self consumption”)
- (“collaborative consumption of” AND energy OR electricity)
- “energy self-sufficiency”
- “transactive energy”
- “swarm electrification”
- “energy community”
  
- (energy OR “electricity AND trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchange\* ) OR (energy OR electricity AND market) OR (“management of” AND “energy supply” OR “electricity supply”) OR (energy OR electricity AND “demand management”) OR (energy OR electricity W/1 “self consumption”) OR (“collaborative consumption of” AND energy OR electricity) OR “energy self-sufficiency” OR “transactive energy” OR “swarm electrification” OR “energy community”

### Element C:

- \*justice
- \*ethic\*
- (social AND right OR distributi\* OR allocati\* OR \*connecti\* OR \*division OR rejecti\*)
- (social AND value OR capital OR benefit OR status OR prominence)
- \*equity
- \*equality

- \*equitab\*
  - \*fairness
  - corrupti\*
  - recognition
  - acknowledgement OR acknowledgment
  - wealth
  - poverty
  - policy
  - legislat\*
  - legal
  - welfare
  - “well-being” OR wellbeing
  - prosper\*
  - access\*
  - discriminat\*
  - prestige
  - reputation
  - infam\*
  - \*ethic\*
  - social\*
  - \*accountab\*
  - bias
  - race
  - gender\*
  - feminist\*
  - ethnic
  - advoca\*
  - marginalis\* OR marginaliz\*
  - socioeconomic OR “socio economic”
  - sociopolitical OR “socio political”
  - stratification
  - minority
  - culture
  - environment\*
- **\*justice OR \*ethic\* OR (social AND right OR distributi\* OR allocati\* OR \*connecti\* OR \*division OR rejecti\*) OR (social AND value OR capital OR benefit OR status OR prominence) OR \*equity OR \*equality OR \*equitab\* OR \*fairness OR corrupti\* OR recognition OR acknowledgement OR acknowledgment OR wealth OR poverty OR policy OR legislat\* OR legal OR welfare OR “well-being” OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR infam\* OR \*ethic\* OR social\* OR \*accountab\* OR bias OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginalis\* OR marginaliz\* OR socioeconomic OR “socio economic” OR sociopolitical OR “socio political” OR stratification OR minority OR culture OR environment\***



# 12/1 – 17/1/2024 – Search strategy testing

## Search string test 1:

- 12/1/2024
- Searching TIT-ABS-KEY
- Language: limited to English
- Type of document: limited to Article
- “peer to peer” OR “p2p” AND (energy OR electricity AND trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchang\*) OR (energy OR electricity AND market) OR (“management of” AND “energy supply” OR “electricity supply”) OR (energy OR electricity AND “demand management”) OR (energy OR electricity W/1 “self consumption”) OR (“collaborative consumption of” AND energy OR electricity) OR “energy self-sufficiency” OR “transactive energy” OR “swarm electrification” OR “energy community” AND \*justice OR \*ethic\* OR (social AND right OR distributi\* OR allocati\* OR \*connecti\* OR \*division OR rejecti\*) OR (social AND value OR capital OR benefit OR status OR prominence) OR \*equity OR \*equality OR \*equitab\* OR \*fairness OR corrupti\* OR recognition OR acknowledgement OR acknowledgment OR wealth OR poverty OR policy OR legislat\* OR legal OR welfare OR “well-being” OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR infam\* OR \*ethic\* OR social\* OR \*accountab\* OR bias OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginalis\* OR marginaliz\* OR socioeconomic OR “socio economic” OR sociopolitical OR “socio political” OR stratification OR minority OR culture OR environment\*
  - **620 results**
  - (with time restriction for 2022-2024: 311 results)
- **A lot of the articles focus on computer science and optimization of the business model, which is not completely wrong, but I think that the focus of the thesis could easily get lost. Further on, I’ll try to get rid of the most general terms that might be misleading the search.**

## Search string test 2:

- **Changes:**
  - Taking out the terms that seem to be too general
  - Took out: OR social\*, OR bias\*, OR (energy OR electricity AND market)
- 15/1/2024
- Searching TIT-ABS-KEY
- Language: limited to English
- Type of document: limited to Article
- “peer to peer” OR “p2p” AND (energy OR electricity AND trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchang\*) OR (“management of” AND “energy supply” OR “electricity supply”) OR (energy OR electricity AND “demand management”) OR (energy OR electricity W/1 “self consumption”) OR (“collaborative consumption of” AND energy OR electricity) OR “energy self-sufficiency” OR “transactive energy” OR

“swarm electrification” OR “energy community” AND \*justice OR \*ethic\* OR (social AND right OR distributi\* OR allocati\* OR \*connecti\* OR \*division OR rejecti\*) OR (social AND value OR capital OR benefit OR status OR prominence) OR \*equity OR \*equality OR \*equitab\* OR \*fairness OR corrupti\* OR recognition OR acknowledgement OR acknowledgment OR wealth OR poverty OR policy OR legislat\* OR legal OR welfare OR “well-being” OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR infam\* OR \*ethic\* OR \*accountab\* OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginalis\* OR marginaliz\* OR socioeconomic OR “socio economic” OR sociopolitical OR “socio political” OR stratification OR minority OR culture OR environment\*

- **578 results**
- (with time restriction for 2022-2024: 299 results)

- **A lot of articles that I’ve retrieved still focus a lot on global or large scale solutions, I would like to focus on smaller scale projects.**

### Search string test 3:

- **Changes:**
  - Try to focus on small scale projects
  - Added a new search element: AND “microgrid\*” OR “micro grid\*” OR “smart local energy”
- 15/1/2024
- Searching TIT-ABS-KEY
- Language: limited to English
- Type of document: limited to Article
- “peer to peer” OR “p2p” AND (energy OR electricity AND trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchang\*) OR (“management of” AND “energy supply” OR “electricity supply”) OR (energy OR electricity AND “demand management”) OR (energy OR electricity W/1 “self consumption”) OR (“collaborative consumption of” AND energy OR electricity) OR “energy self-sufficiency” OR “transactive energy” OR “swarm electrification” OR “energy community” AND \*justice OR \*ethic\* OR (social AND right OR distributi\* OR allocati\* OR \*connecti\* OR \*division OR rejecti\*) OR (social AND value OR capital OR benefit OR status OR prominence) OR \*equity OR \*equality OR \*equitab\* OR \*fairness OR corrupti\* OR recognition OR acknowledgement OR acknowledgment OR wealth OR poverty OR policy OR legislat\* OR legal OR welfare OR “well-being” OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR infam\* OR \*ethic\* OR \*accountab\* OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginalis\* OR marginaliz\* OR socioeconomic OR “socio economic” OR sociopolitical OR “socio political” OR stratification OR minority OR culture OR environment\* AND “microgrid\*” OR “micro grid\*” OR “smart local energy”
  - **123 results**
- **This search does not include any of the articles that I based my research design on. I miss authors such as Singh et al., Zhou et al. and Adams. I think that this means that something is wrong with my string. I checked Scopus, and the articles are there, so it is definitely my string. I think the goal would be to rethink the search elements and include terms such as: energy trilemma,**

**distributional impacts, energy transition, off grid energy systems, and anthropologic/sociologic/social sciences perspective.**

- (deep OR reinforce\* OR machine AND learning) OR stochastic\* OR “system architecture” OR computati\*

<b>A</b>	<b>A1</b>	<b>B</b>	<b>C</b>	<b>D (and not)</b>
P2P	<b>microgrid</b>	Energy trading	Justice	<b>Deep learning</b>
Peer to peer	<b>Micro grid</b>	Power trading	Injustice	<b>Reinforced learning</b>
Peer-to-peer	<b>off-grid</b>	Energy swapping	Social rights	<b>Deep reinforced learning</b>
	<b>off-the-grid</b>	Energy purchasing	Social Equity	<b>Machine learning</b>
	<b>local energy network</b>	Energy selling	Social Inequity	<b>Stochastic programming</b>
	<b>local electricity network</b>	Energy sharing	Fairness	<b>Stochastic optimisation</b>
	<b>Distributed energy systems</b>	Energy exchange	Unfairness	<b>System architecture</b>
	<b>Distributed energy network</b>	Electricity trading	Equitability	<b>Computation</b>
	<b>Decentralised grid</b>	Electricity swapping	Corruption	
	<b>Decentralised energy systems</b>	Electricity purchasing	Social distribution	
	<b>Decentralised energy network</b>	Electricity selling	Social allocation	
		Electricity sharing	Social connection	
		Electricity exchange	Social disconnection	
		Management of energy supply	Social redivision	
		Energy demand management	Recognition	
		Power supply management	Social rejection	

		Energy self-consumption	<b>Social security</b>	
		Self-consumption of energy	Acknowledgement	
		Electricity self-consumption	Poverty	
		Self-consumption of electricity	Social value	
		Collaborative consumption of energy	Social capital	
		Collaborative consumption of electricity	Policy	
		Power self-sufficiency	Legislative	
		Energy self-sufficiency	Legislation	
		Transactive energy	Legal	
		Swarm electrification	Wealth	
		Energy community	Welfare	
		<b>Energy transition</b>	Well-being	
			Prosperity	
			Social benefit	
			Access	
			Discrimination	
			Social status	
			Prestige	
			Social prominence	
			Reputation	
			Infamy	
			Ethics	
			Race/racial	
			Gender	
			Feminist	

			Ethnic	
			Advocacy	
			Marginalisation	
			socioeconomic	
			sociopolitical	
			Stratification	
			Minorities	
			Culture	
			<b>Distributional impacts</b>	
			<b>sociology</b>	
			<b>anthropology</b>	

#### Search string test 4:

- **Changes:**
  - Consolidated the new search element A1 and added the terms that are in bold in the table above
  - Also added “social preferences” “social attitude”
- 15/1/2024
- Searching TIT-ABS-KEY
- Language: limited to English
- Type of document: limited to Article
  
- “peer to peer” OR “p2p” AND microgrid\* OR “micro grid\*” OR “off the grid” OR “off grid” OR “local energy network” OR “local electricity network” OR ( distributed OR decentrali?ed AND energy) OR electricity AND grid OR network OR system AND (energy OR electricity AND trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchang\*) OR (“management of” AND “energy supply” OR “electricity supply”) OR (energy OR electricity AND “demand management”) OR (energy OR electricity W/1 “self consumption”) OR (“collaborative consumption of” AND energy OR electricity) OR “energy self sufficiency” OR “transactive energy” OR “swarm electrification” OR “energy community” OR “energy transition” AND \*justice OR \*ethic\* OR (social AND preference OR attitude OR right OR distributi\* OR allocati\* OR \*connecti\* OR \*division OR rejecti\*) OR (social AND value OR capital OR benefit OR status OR prominence) OR \*equity OR \*equality OR \*equitab\* OR \*fairness OR corrupti\* OR recognition OR acknowledg\*ment OR wealth OR poverty OR policy OR legislat\* OR legal OR welfare OR “well being” OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR infam\* OR \*ethic\* OR \*accountab\* OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginalis\* OR marginaliz\* OR socioeconomic OR “socio economic” OR sociopolitical OR “socio political” OR

stratification OR minorit\* OR cultur\* OR “distributional impact\*” OR sociolog\* OR anthropolog\*

- **365 results**
- (with time restriction for 2022-2024: 195 results)
- **I get a lot of results focusing on programming and deep reinforced learning – these articles are mostly about technical solutions and programming, I will try to eliminate them.**

## Search string test 5:

- **Changes:**
  - Added the condition AND NOT to filter out deep and reinforced learning and stochastic programming and stochastic optimization, machine learning, system architecture – the goal is to minimise articles that focus on programming and the architecture behind the blockchain technology – I cannot exclude the blockchain directly because it is used as a keyword in many articles that focus on more broad topics as it is one of the core enabling technologies as well as a trending “buzzword”
- 15/1/2024
- Searching TIT-ABS-KEY
- Language: limited to English
- Type of document: limited to Article
- “peer to peer” OR “p2p” AND microgrid\* OR “micro grid\*” OR “off the grid” OR “off grid” OR “local energy network” OR “local electricity network” OR ( distributed OR decentrali?ed AND energy) OR electricity AND grid OR network OR system AND (energy OR electricity AND trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchang\*) OR (“management of” AND “energy supply” OR “electricity supply”) OR (energy OR electricity AND “demand management”) OR (energy OR electricity W/1 “self consumption”) OR (“collaborative consumption of” AND energy OR electricity) OR “energy self sufficiency” OR “transactive energy” OR “swarm electrification” OR “energy community” OR “energy transition” AND \*justice OR \*ethic\* OR (social AND preference OR attitude OR right OR distributi\* OR allocati\* OR \*connecti\* OR \*division OR rejecti\*) OR (social AND value OR capital OR benefit OR status OR prominence) OR \*equity OR \*equal\* OR \*equitab\* OR \*fairness OR corrupti\* OR recognition OR acknowledg\*ment OR wealth OR poverty OR policy OR legislat\* OR legal OR welfare OR “well being” OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR infam\* OR \*ethic\* OR \*accountab\* OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginalis\* OR marginaliz\* OR socioeconomic OR “socio economic” OR sociopolitical OR “socio political” OR stratification OR minorit\* OR cultur\* OR “distributional impact\*” OR sociolog\* OR anthropolog\* AND NOT (deep OR reinforc\* OR machine AND learning) OR stochastic\* OR “system architecture” OR computati\*
- **286 results**
- (with time restriction for 2022-2024: 139 results) 5A
- (with time restriction for 2023-2024: 79 results) 5B

- The retrieved articles from the test string 5B look relevant and seem like they make a big enough corpus of literature to work with. The next step therefore will be to focus on the inclusion and exclusion criteria. Once the criteria is done, I will translate the string to the WoS syntax and start with the extraction.

## Translation of the test string 5 for WoS:

- 17/1/2024
- Searching TIT-ABS-KEY (in WoS called Topic)
- Language: limited to English
- Type of document: limited to Article
- TS=((“peer to peer” OR p2p) AND (microgrid\* OR “micro grid\*” OR “off the grid” OR “off grid” OR “local energy network” OR “local electricity network” OR ((distributed OR decentralised) AND (energy OR electricity) AND (grid OR network OR system))) AND (((energy OR electricity) AND (trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchang\*)) OR (“management of” AND (“energy supply” OR “electricity supply”)) OR ((energy OR electricity) AND “demand management”) OR ((energy OR electricity) Near/1 “self consumption”) OR (“collaborative consumption of” AND (energy OR electricity)) OR “energy self sufficiency” OR “transactive energy” OR “swarm electrification” OR “energy community” OR “energy transition”) AND (justice OR injustice OR ethic\* OR unethic\* OR (social AND (preference OR attitude OR right OR distributi\* OR allocati\* OR connecti\* OR disconnecti\* OR division OR redivision OR rejecti\*)) OR (social AND (value OR capital OR benefit OR status OR prominence)) OR equity OR inequity OR equal\* OR unequal\* OR equitab\* OR inequitab\* OR fairness OR unfairness OR corrupti\* OR recognition OR acknowledgment OR wealth OR poverty OR policy OR legislat\* OR legal OR welfare OR “well being” OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR infam\* OR ethic\* OR unethic\* OR accountab\* OR unaccountab\* OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginalis\* OR marginaliz\* OR socioeconomic OR “socio economic” OR sociopolitical OR “socio political” OR stratification OR minorit\* OR cultur\* OR “distributional impact\*” OR sociolog\* OR anthropolog\*) NOT (((deep OR reinforc\* OR machine) AND learning) OR stochastic\* OR “system architecture” OR computati\*))
  - **248 results**
  - (with time restriction for 2022-2024: 108 results) 5A
  - (with time restriction for 2023-2024: 59 results) 5B

## 16/1 – 24/1/2024 – Search strategy: setting eligibility criteria

### GOAL:

- Set transparent and logical criteria to include or exclude articles from the search.
  - Provide a transparent explanation for all the given criteria.
- Work with the RQs and the proposal to find focus and define well the articles that I am interested in.

- I will most probably need to define which type of projects I am interested in – energy supply for households, e-mobility, off-grid or hybrid...
- Also if I want to focus on articles about specific projects only, or also about the legislation and systemic changes such as white certificates
- Another potential criterion would be to exclude/include certain phases of project development such as technical design and system architecture during the development phase of the project or model

## Objective and RQs (taken from the proposal)

As explained above, the P2P configurations are at the core of currently popular movements such as the sharing economy or collaborative society. The rhetoric surrounding these movements portrays the P2P projects and services as the potential enablers of a more democratic, participatory and just society. However, the promising assumptions are already being challenged in the academic literature. Side by side to this debate, the application of the P2P model to energy trading is said to bring a more accessible and justly distributed access to sustainable energy. However, the ability of P2P energy trading to produce effects on energy justice is still a relatively new and understudied area. Therefore the objective of this thesis is to gain a better understanding of the relation between the P2P energy trading and energy justice. Therefore, I will scrutinise the existing assumptions regarding the effects of P2P energy trading on energy justice. To do so, I will answer the following set of research questions.

- **RQ:** What makes it more likely for peer-to-peer energy trading to produce effects on energy justice?
    - **SQ1:** What processes and practices affecting energy justice are enabled by the P2P energy trading?
    - **SQ2:** How do the directly engaged actors of the P2P energy trading shape the identified processes and practices?
    - **SQ3:** Which external conditions affect the performance of the P2P energy trading configuration in terms of energy justice?
1. To answer the RQ about actors I need to engage with articles that capture the different roles and positions of the actors. Therefore I need to specify whom do I understand as the “**directly engaged actors**”.
  2. To answer the RQ about processes and practices, I need to engage with literature that will introduce and describe them. Given that the point of the RQ is to identify the practices/processes, I should specify the bigger context of **when, where and by whom the processes of interest should be done**.
  3. To answer the RQ about external conditions I need to engage with **articles that evaluate or report on the context, setting and performance of the projects**. Therefore I need articles that cover the already applied and running projects.
- **The directly engaged actors:**
    - Users, distributors, developers, legislators, business owners
    - It is hard to come up with criteria to limit the articles based on the actors they would engage with.
  - **Specification about the processes and practices that I am interested in:**
    - I am interested primarily in applied and running projects.



- The processes that I am interested in discovering and describing should ideally cover the some form of interactions with the end users/providers or “supervisors” (e.g. the organisations or institutions that have a say in the functioning or such)
- 
- **Specification of the stages in which are the projects that the articles should and should not cover:**

I think the above developed approach will not work. I’ve tried to work on it for a few days, and only later I realised that the articles would be very hard to fit in, if I was working on exclusion criteria. When contrasted with the real articles, all the potential categories for exclusion got blurry and non-transparent. I would also have to create a lot of arbitrary(premeditated) categories to fit my articles in – such as thinking about the stages of P2PET or defining engaged actors beforehand. That could prove to be misleading. The other option would be to base these criteria on the articles retrieved through the test string searches, which would be biased. Therefore, I decided to abandon this method of criteria setting and will pursue a different approach. I want to try to derive my inclusion criteria from the EJ framework proposed by Jenkins et al. (2016).

## Energy justice framework by Jenkins et al. (2016):

- Based on the framework proposed in the article by Jenkins et al. (2016), Energy justice can be viewed as a 3-tenet construct composed of:
  - Distributional justice
  - Justice as recognition
  - Procedural justice
- I can use these concepts to create inclusion criteria for the articles. I want to focus on inclusion criteria, because, as described above, exclusion criteria might end up being too restrictive and potentially biased. Thus by setting inclusion criteria, I want to make sure the articles that enter the corpus share the desired focus. Elaborated further on in the document.

## Eligibility criteria (test 1)

### General filters used for the search:

- **Time restriction:** year of publication 2023–2024
  - **Reasoning:** The search strategy yielded a lot of retrieved articles from multiple academic fields and to cover them without a time restriction would not be possible within the scope of this thesis. Also there are already some SLRs that have been done previously, and that have pointed the direction for my research, therefore I do not wish to duplicate the efforts. Given the publication process, my thesis proposal was based on findings from SLRs that have been covering the articles of 2022 at the latest. Therefore newer articles still need to be covered.
- **Type of document:** Article published in a Journal
  - **Reasoning:** Given the scope of the research, I would not have enough time and expertise to assess the eligibility of the articles according to their academic quality, therefore I decided to include published papers only.

- **Stage of publication process:** Final and in press
  - **Reasoning:** Both stages include only articles that have been fully accepted for print and are either already published or in the process of being published. Therefore, the academic quality of the contents should be high enough to be used for the review.
- **Language of the document:** English
  - **Reasoning:** For a more thorough analysis and a more transparent pattern identification, I decided to go for a unilingual corpus. Therefore I opted for the one with the most extensive database – English.

## Criteria for inclusion of retrieved articles:

1. **Articles describing and/or reporting on the people and actors that are engaged in the P2PET.** The focus of the articles should be their experience, attitudes, perception and preferences. Special focus on minority groups or generally underrepresented groups of people (based on ethnicity, gender, social class, age, physical/mental abilities). This criterion covers the EJ framework tenet for justice as recognition.
  - The underlying aim is to uncover who are those engaged/disengaged, affected/benefiting from the P2PET.
2. **Articles describing and/or reporting on the socio-technical configurations of the P2PET projects.** Therefore, articles focusing on the distribution, accessibility and reliability of P2PET physical infrastructure and services, distribution of benefits and ills related to P2PET.
  - The underlying aim is to gain knowledge on what is the concern about P2PET.
3. **Articles describing and/or reporting the acts and procedures of assessing, advocating for and addressing the reparation/mitigation/prevention of the ills as well as focusing on the legal and social calls in favour of EJ.**
  - The underlying aim is to gain knowledge about what is/can be done, and how the injustice is addressed – and how is that going.

## Criteria for exclusion of retrieved articles:

1. **Exclude articles that do not focus on energy trading.**
  - To check that the focus is still right. I've encountered articles that do pass the search, but are irrelevant for the analysis. This goes for the articles that talk about the different possibilities of further use, or general renewable energy legislation.
    - However, I would include articles that focus on legislation about the trading itself, or that enable/disable it
    - I care about the fact of people somehow exchanging energy or sharing it within a closed community – swapping/trading/exchange all work for me, the important thing is that the **people manage their need/supply by interacting with other community members.**
2. **Exclude articles that focus on technical solutions for the components of P2PET configurations.**
  - Such as technical solutions of the models, the programming/optimization algorithms, system architecture, and data security mechanisms.

- **Applying keywords restriction on terms leading to the technology used through AND NOT, is usually too restrictive** – keywords often mention the technology even if the article focuses on other aspects.
- **I do use keywords to restrict the articles that indicate actions and fields that point to programming** – I decided to leave out terms described in the last search element: **(deep OR reinforc\* OR machine AND learning) OR stochastic\* OR “system architecture” OR computati\***
- The rationale is that the articles diverge from the intended focus and I do not have the erudition to enter the analysis.
- **Exclude articles that focus purely on financial optimization, and increase of financial benefits and incentives.**
  - A lot of articles are business oriented with the aim to prioritise the economic indicators and maximise financial benefits. Although these articles usually have a “social welfare goal” this is defined as economic benefit, therefore it diverges from the focus of the research.

## To be included in the corpus:

- In order to be included in the final corpus, an article needs to pass through the search filters, fit into at least 1 of the 3 inclusion criteria and not be excluded based on the 3 exclusion criteria.

**POTENTIAL FILTERS/CRITERIA TO ADD TO CONSIDER (in case I still have too many articles):**

- **Geographical area** – potentially I could only focus on global south, but I don’t think that this would be possible - I should screen the articles and get to a ratio in the 2023–2024 projects to estimate the chances that I have to get enough articles with an geo-area restriction
- **Energy-sources** – I could only limit my search to renewable energies or solar energy

## 25/1/2024 – Search strategy: reflexion on eligibility criteria

**GOAL:**

- **Summarise the thoughts and ideas that I came up with during the screening of the articles retrieved by the test string 5B.**
- **Draw from the thoughts and present ideas to move forward with the search strategy.**

## Reflexion on eligibility criteria

- I used the articles retrieved by test string 5B from Scopus and tried the screening procedure on them. I applied the general search filters and tried to adhere to the criteria that are described above and these are my thoughts about the process.
  - Originally I retrieved 79 articles
    - **Filters:**

- All worked fine, nothing sparked my particular interest or importance.
- **Inclusion criteria:**
  - I think that overall, these just added confusion as sometimes the focus of the article was hard to attribute to a concrete criterion and generally it just showed the differences between the styles of the abstracts.
  - If I were to apply them to the final search, I would need to provide a rationale for each included/excluded article.
  - I think the criteria will be useful for analysis, but probably not for the search strategy itself.
- **Exclusion criteria:**
  - During the screening, it was pretty obvious which articles do not focus on P2PET, therefore, I could eliminate those easily.
    - **Criterion can stay as it is.**
  - However, it was much more difficult to distinguish between articles that are proposing a technical solution and which just use programming and technology to answer deeper questions. Many articles propose models and use simulations and explain their functioning. It is complicated to draw a transparent line between those articles and those which focus on solving a technical problem.
    - **Criterion regarding technical solution needs to be refined. Technical solution needs to be better specified.**
  - I also had a hard time applying the “financial benefit” criterion. Many articles propose a model that aims to optimise the trading. Given the different writing styles and a variety of information included in the articles, it is complicated to see which articles focus merely on financial optimisation and which have other goals.
    - **Criterion regarding financial optimisation needs to be refined, probably eliminated and substituted by another.**
- After applying the eligibility criteria I could transparently get the number of articles down to 62, which is still too much for me to take on.
  1. I realised that a lot of articles that do not make a clear cut, include the phrase “social welfare”. I suspect that this phrase makes it possible for such articles to enter the search. I will therefore eliminate it from the search string and see how the search changes.
  2. I think that the way I use search terms to eliminate articles focusing on coding, and deep/reinforcement learning is not very systematic, I might try to leave that search element out and restrict the search through limiting the subject areas of the search
  3. It would be a radical step to eliminate all the articles that propose a model. I think the articles could include valuable information, however, I am not sure if I am capable of analysing them given the broad use of economic terms. There are 2 possible paths to consider:
    - a. Stick to the super up-to-date state of the art articles (2022–2024 roughly) and include these articles.
    - b. Widen my time scope and exclude them.

# 26/1/2024 – Search strategy: iteration of search string

## OUTCOME:

- The above explained reasons led me to refine the search string. As I was texting the string, I came across the subject area filter in Scopus. I decided to try to use it as a way to avoid a conceptually complex inclusion/exclusion criteria to filter out most of the articles that focus on providing the technical solutions to problems related to P2PET. However, I am not sure whether this step is a legitimate choice. I sent an email to Sietze asking about the validity of this step, but will also do some research about it myself.

## Search string test 6:

- **Changes:**
  - took out the “social welfare” search term
  - Took out the restrictive search element, because it was not fully developed and systematic
  - Applied the “subject area” filter omitting the following fields:
    - Mathematics
    - Materials science
    - Computer science
- **info:**
  - 26/1/2024
  - Database: Scopus
  - Searching TIT-ABS-KEY
  - Language: limited to English
  - Type of document: limited to Article
  - Subject area: NOT mathematics OR computer science OR materials science OR physics and astronomy OR chemical engineering OR chemistry OR biochemistry, genetics and molecular biology
- “peer to peer” OR “p2p” AND microgrid\* OR “micro grid\*” OR “off the grid” OR “off grid” OR “local energy network” OR “local electricity network” OR (distributed OR decentrali?ed AND energy) OR electricity AND grid OR network OR system AND (energy OR electricity AND trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchang\*) OR (“management of” AND “energy supply” OR “electricity supply”) OR (energy OR electricity AND “demand management”) OR (energy OR electricity W/1 “self consumption”) OR (“collaborative consumption of” AND energy OR electricity) OR “energy self sufficiency” OR “transactive energy” OR “swarm electrification” OR “energy community” OR “energy transition” AND \*justice OR \*ethic\* OR (social AND preference OR attitude OR right OR distributi\* OR allocati\* OR \*connecti\* OR \*division OR rejecti\*) OR (social AND value OR capital OR status OR prominence) OR \*equity OR \*equal\* OR \*equitab\* OR \*fairness OR corrupti\* OR recognition OR acknowledg\*ment OR wealth OR poverty OR policy OR legislat\* OR legal OR “well being” OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR infam\* OR \*ethic\* OR \*accountab\* OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginalis\* OR marginaliz\* OR socioeconomic OR “socio

economic" OR sociopolitical OR "socio political" OR stratification OR minorit\* OR cultur\* OR "distributional impact\*" OR sociolog\* OR anthropolog\*

- **182 results**
- (with time restriction for 2022-2024: 99 results) 6A
- (with time restriction for 2023-2024: 62 results) 6B

## 28/1/2024 – Search Strategy: iteration and testing

### GOAL:

- The goal for today is to come up with some variations of the possible corpora that I can get with the use of the last search string (test 6) by adapting the search filters. The goal is to come up with alternatives for the use of WoS Categories and Scopus subject area filters.

### Test string 7:

- **Changes:**
  - Applied the "subject area" filter only showing social science papers
  - Changed the subject area to social sciences only
- **info:**
  - 28/1/2024
  - Database: Scopus
  - Searching TIT-ABS-KEY
  - Language: limited to English
  - Type of document: limited to Article and conference paper
  - Subject area: social sciences
- TITLE-ABS-KEY ( "peer to peer" OR "p2p" AND microgrid\* OR "micro grid\*" OR "off the grid" OR "off grid" OR "local energy network" OR "local electricity network" OR ( distributed OR decentrali?ed AND energy ) OR electricity AND grid OR network OR system AND ( energy OR electricity AND trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchang\* ) OR ( "management of" AND "energy supply" OR "electricity supply" ) OR ( energy OR electricity AND "demand management" ) OR ( energy OR electricity W/1 "self consumption" ) OR ( "collaborative consumption of" AND energy OR electricity ) OR "energy self sufficiency" OR "transactive energy" OR "swarm electrification" OR "energy community" OR "energy transition" AND \*justice OR \*ethic\* OR ( social AND preference OR attitude OR right OR distributi\* OR allocati\* OR \*connecti\* OR \*division OR rejecti\* ) OR ( social AND value OR capital OR status OR prominence ) OR \*equity OR \*equal\* OR \*equitab\* OR \*fairness OR corrupti\* OR recognition OR acknowledg\*ment OR wealth OR poverty OR policy OR legislat\* OR legal OR "well being" OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR infam\* OR \*ethic\* OR \*accountab\* OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginalis\* OR marginaliz\* OR socioeconomic OR "socio economic" OR sociopolitical OR "socio political" OR stratification OR minorit\* OR cultur\* OR "distributional impact\*" OR sociolog\* OR anthropolog\* ) AND ( LIMIT-TO ( SUBJAREA , "SOCI" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) ) AND ( LIMIT-TO ( DOCTYPE , "cp" ) OR LIMIT-TO ( DOCTYPE , "ar" ) )
  - **41 results**

## Test string 8:

- **Changes:**
  - Changed the subject area to social sciences + environmental sciences
- **info:**
  - 28/1/2024
  - Database: **Scopus**
  - Searching TIT-ABS-KEY
  - Language: limited to English
  - Type of document: limited to Article and conference paper
  - Subject area: social sciences, environmental sciences
- TITLE-ABS-KEY ( "peer to peer" OR "p2p" AND microgrid\* OR "micro grid\*" OR "off the grid" OR "off grid" OR "local energy network" OR "local electricity network" OR ( distributed OR decentrali?ed AND energy ) OR electricity AND grid OR network OR system AND ( energy OR electricity AND trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchang\* ) OR ( "management of" AND "energy supply" OR "electricity supply" ) OR ( energy OR electricity AND "demand management" ) OR ( energy OR electricity W/1 "self consumption" ) OR ( "collaborative consumption of" AND energy OR electricity ) OR "energy self sufficiency" OR "transactive energy" OR "swarm electrification" OR "energy community" OR "energy transition" AND \*justice OR \*ethic\* OR ( social AND preference OR attitude OR right OR distributi\* OR allocati\* OR \*connecti\* OR \*division OR rejecti\* ) OR ( social AND value OR capital OR status OR prominence ) OR \*equity OR \*equal\* OR \*equitab\* OR \*fairness OR corrupti\* OR recognition OR acknowledg\*ment OR wealth OR poverty OR policy OR legislat\* OR legal OR "well being" OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR infam\* OR \*ethic\* OR \*accountab\* OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginalis\* OR marginaliz\* OR socioeconomic OR "socio economic" OR sociopolitical OR "socio political" OR stratification OR minorit\* OR cultur\* OR "distributional impact\*" OR sociolog\* OR anthropolog\* ) AND ( LIMIT-TO ( SUBJAREA , "SOCI" ) OR LIMIT-TO ( SUBJAREA , "ENVI" ) ) AND ( LIMIT-TO ( DOCTYPE , "cp" ) OR LIMIT-TO ( DOCTYPE , "ar" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )
  - **113 results**
- **I imported the data to an excel sheet and tried to play around with the keywords a bit. If I excluded all the optimization and simulations & modelling without time restrictions, I could get to circa 59 articles (with a time span from 2016 till 2024).**
  - **That could be one way of assembling my future corpus once I add the refined exclusion criteria.**
  - **The pros of this decision would be that I could probably get rid of the majority of the technical articles that deal with future proposals and scenarios, and also those that include a lot of programming which is not my strong side. It should therefore make it easier for me to create exclusion/inclusion criteria without getting stuck with the articles that I do not understand due to my academic background.**
- **Another possible way to go about it would be to limit the time span. With a time restriction 2022–2024 I could get to 53 articles while including all the simulation & modelling, plus optimization articles. This would probably still leave me with the problem of defining a technical solution and creating a good**

**inclusion/exclusion criteria. I think that the added value on the other hand would be the “up to date” status of this search.**

- **info:**
  - 28/1/2024
  - Database: **WoS**
  - Searching TS
  - Language: limited to English
  - Type of document: limited to Article (no cp found)
  - Subject area: social sciences, environmental sciences
  
- TS=((("peer to peer" OR p2p) AND (microgrid\* OR "micro grid\*" OR "off the grid" OR "off grid" OR "local energy network" OR "local electricity network" OR ((distributed OR decentralised) AND (energy OR electricity) AND (grid OR network OR system))) AND (((energy OR electricity) AND (trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchang\*)) OR ("management of" AND ("energy supply" OR "electricity supply")) OR ((energy OR electricity) AND "demand management") OR ((energy OR electricity) Near/1 "self consumption") OR ("collaborative consumption of" AND (energy OR electricity)) OR "energy self sufficiency" OR "transactive energy" OR "swarm electrification" OR "energy community" OR "energy transition") AND (justice OR injustice OR ethic\* OR unethic\* OR (social AND (preference OR attitude OR right OR distributi\* OR allocati\* OR connecti\* OR disconnecti\* OR division OR redivision OR rejecti\*)) OR (social AND (value OR capital OR benefit OR status OR prominence)) OR equity OR inequity OR equal\* OR unequal\* OR equitab\* OR inequitab\* OR fairness OR unfairness OR corrupti\* OR recognition OR acknowledgment OR wealth OR poverty OR policy OR legislat\* OR legal OR "well being" OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR infam\* OR ethic\* OR unethic\* OR accountab\* OR unaccountab\* OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginalis\* OR marginaliz\* OR socioeconomic OR "socio economic" OR sociopolitical OR "socio political" OR stratification OR minorit\* OR cultur\* OR "distributional impact\*" OR sociolog\* OR anthropolog\*)) AND WC=(SOCIAL SCIENCES OR ENVIRONMENTAL SCIENCE)
  - **12 results**

## Test string 9:

- **Changes:**
  - I added a search element eliminating the optimisation, modelling and simulation articles
- **info:**
  - 28/1/2024
  - Database: **Scopus**
  - Searching TIT-ABS-KEY
  - Language: limited to English
  - Type of document: limited to Article and conference paper
  - Subject area: social sciences, environmental sciences
  
- TITLE-ABS-KEY ( "peer to peer" OR "p2p" OR "peer-to-peer" AND microgrid\* OR "micro grid\*" OR "off the grid" OR "off grid" OR "local energy network" OR "local electricity network" OR ( distributed OR decentrali?ed AND energy ) OR electricity AND grid OR network OR system AND ( energy OR electricity AND trad\* OR swap\*



OR purchas\* OR sell\* OR shar\* OR exchang\* ) OR ( "management of" AND "energy supply" OR "electricity supply" ) OR ( energy OR electricity AND "demand management" ) OR ( energy OR electricity W/1 "self consumption" ) OR ( "collaborative consumption of" AND energy OR electricity ) OR "energy self sufficiency" OR "transactive energy" OR "swarm electrification" OR "energy community" OR "energy transition" AND \*justice OR \*ethic\* OR ( social AND preference OR attitude OR right OR distributi\* OR allocati\* OR \*connecti\* OR \*division OR rejecti\* ) OR ( social AND value OR capital OR status OR prominence ) OR \*equity OR \*equal\* OR \*equitab\* OR \*fairness OR corrupti\* OR recognition OR acknowledg\*ment OR wealth OR poverty OR policy OR legislat\* OR legal OR "well being" OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR infam\* OR \*ethic\* OR \*accountab\* OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginalis\* OR marginaliz\* OR socioeconomic OR "socio economic" OR sociopolitical OR "socio political" OR stratification OR minorit\* OR cultur\* OR "distributional impact\*" OR sociolog\* OR anthropolog\* AND NOT model\*ing OR simulation OR optimi?ation ) AND ( LIMIT-TO ( SUBJAREA , "SOCI" ) OR LIMIT-TO ( SUBJAREA , "ENVI" ) ) AND ( LIMIT-TO ( DOCTYPE , "cp" ) OR LIMIT-TO ( DOCTYPE , "ar" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )

- 56 results

#### FOR TOMORROW:

- Export the articles from test string 9 and screen them to see how the assumptions made today would stand its ground.
- Check the columns document sent by Sietze and check if the same document is possible for me to form with the information that I have now.
- Learn about how the exportation process should look like and also ask Sietze about what the database should have? Can I use Mendeley or do I need Zotero?
  - Potentially install atlas.ti and watch some videos about how to use it properly.

## 29/1/2024 – Search strategy: iteration and testing

#### GOAL:

- To screen the articles from test string 9, prepare material for evaluation of the strung and the strategy as a whole.
- Check the documents Sietze sent me.

## Final presentation of search strategy

Regarding the documents with examples of search columns sent to me by Sietze, I think I'm fine with the table that I created in this document. For the final presentation of the search strategy, I will need to:

- come up with names for each search element
- join the search elements with the right operators
- Incorporate the last search element that filters out the optimisation, simulation and modelling from the search (if I end up using this search element)
- Join the final versions of the search strings for both databases and write the number of retrieved results

## Screening the retrieved results of test string 9 1/2:

I need to refine the exclusion criteria before screening. Based on the insights noted in this logbook on 25/01/2024, I will rework the exclusion criteria, and will omit the inclusion criteria set before the first screening round and discarded through the consequent reflection.

- **Exclusion criteria:**
  - **Other than primary focus on P2PET.**
    - To exclude an article based on this criterion at least one of the following conditions needs to be met:
      - The article does **not explicitly focus** on energy trading under **the P2P configuration.**
      - The article does **not explicitly focus on the practices, processes, and or the actors of energy trading, or the aspects of physical infrastructure and or the services enabling energy trading.** A broad understanding of the term “trading” is used including sharing, swapping, exchange and similar activities of collaborative energy consumption and management.
  - **Proposing a technical solution.**
    - To exclude an article based on this criterion, both of the following conditions need to be met:
      - **The article is of a technical nature.** As I define it, the main aim of the article is to introduce, propose or review a technical solution or a technical innovation to either the physical infrastructure or the services of the P2PET.
      - The screened fields of the article (title, abstract, keywords) do **not explicitly indicate a secondary focus** on the social or energy justice topics.
  - (Focus on financial or technical optimisation.) – **This criterion is left here to be potentially used if necessary, as for the cases of articles with this focus still passed the search.**
- **I think that the financial optimization criterion will be needed. So far, I’ve screened about a half of the retrieved articles, and I already identified 3 articles that would probably fall into this category. Otherwise the criteria hold on well, tomorrow I’ll finish the screening and evaluate them.**

## 30/1/2024 – Search strategy: iteration and testing

### GOAL:

- **Finish screening the articles from test string 9.**
- **Evaluate how the exclusion criteria hold.**
- **Evaluate if the search string retrieves desired articles.**

## Screening test string 9 2/2:

- 16 out of the 57 screened articles did not pass the screening based on the 2 exclusion criteria (other than primary focus on P2PET & proposing a technical solution)
  - 5 articles are categorised as proposing a technical solution
  - 11 are categorised a other than primary focus on P2PET
- 4 articles were found to belong to the financial and/or technical optimisation category
- **FOR TOMORROW:**
  - **Analyse if there is some systemic way to eliminate the 11 articles from the search**
  - **Analyse if there is some systemic way to catch the 4 articles by the AND NOT search element**

## 31/1/2024 – Search strategy: iteration and testing

- I tried to come up with a way to eliminate the 4 articles that propose an optimisation or a financial model and there are probably no clean cut ways
  - I could eliminate the search term algorithm which would eliminate 4 of the excluded articles while also eliminating 4 of the currently included articles
  - From the terms that I tried to apply, all of them eliminated more of the included than the excluded articles
- What I find problematic is that the close relation of the technology to the studied topic, it is difficult to exclude articles based on technical keywords such as blockchain, programming, algorithm or such. As articles that are in my targeted scope also use them.
- I think that the goal for now is to confirm with Sietze that the use of the subject area filters is valid and then to argue in the methodology section that the nature of the article needs a manual selection for inclusion or exclusion.

Today I have also thought and reflected about some of the methodological issues that I am dealing with now regarding the next steps of the process.

### **Subject area filters:**

- I did some quick online reading about the use of subject area/topic filters for SLR and the results are inconclusive. The problem about the use of these filters is that they supposedly organise articles into topics according to the journal they are in, therefore, the categorisation is not necessarily that accurate. Thus, if I decide to use them, I would need to find some literature to support that decision.

### **Screening:**

- I was also thinking about whether it is valid to disqualify a large number of articles during the screening process, or whether the goal would be to alter the search strategy to get rid of the not wanted articles through the search string. I consulted some SLRs, and it seems like the practical procedure counts on disqualifying a larger number of articles during the screening process. The important part about this is that this can only be done if the eligibility criteria are well-defined and absolutely transparent, which is something I'm still struggling with.

### **Cross-reference check:**

- I also was considering the method of cross-referencing to identify relevant articles that otherwise could end up not making it in the corpus. I did some reading on it and even though many SLRs do use cross-referencing as a step in the search strategy, I've read that it is not exactly an efficient method as it is usually highly time consuming and does not guarantee results. Given that I don't have a lot of time for my thesis, I will ask Sietze about whether I should take this step. As of right now, I don't see any major advantages of doing it.

## 5/2/2024 – Search strategy: iteration and testing

Tomorrow I have a meeting with Sietze, so the goal for today is to prepare for that meeting. I need to consolidate the documents I want to show and discuss tomorrow, collect questions and prepare the agenda for the meeting.

### TO DO:

- **create search element table**
- **Make sure I use uniform rules across the set of search terms and search string**
- **Check if the uniformization of the changes affected the outcomes of the search**
- **Go through the logbook and gather questions**
- **Summarise eligibility criteria**
- **Use search terms in the correct search forms for Scopus and WoS**

Questions for Sietze for the 6/2/2024 meeting:

- Do you think cross-referencing is a requirement for me? Should I use cross-referencing to add literature to my corpus? I don't really want to do it as it is too unstructured, not very efficient and time consuming.
- Are there any requirements on software that I should use for the screening of the articles? I remember talking about some online database of analysed articles that I needed to make available for the submission of the thesis. I know, there was some sort of a recommended programme to do that with, but I don't know which one that was. Maybe Zotero?
- What should my next steps be? ( Discussion)

## 6/2/2024 – Search strategy: iteration and testing

### Meeting with Sietze:

- **Do you think cross-referencing is a requirement for me? Should I use cross-referencing to add literature to my corpus? I don't really want to do it as it is too unstructured, not very efficient and time consuming.**
  - Sietze is fine with me skipping this step. Does not have any points or comments about it. Supports my decision.
- **Are there any requirements on software that I should use for the screening of the articles? I remember talking about some online database of analysed articles that I needed to make available for the submission of the thesis. I know, there was some sort of a recommended programme to do that with, but I don't know which one that was. Maybe Zotero?**

- Probably the best programme to use is Zotero as it is open access, and therefore my database would stay accessible even when my institutional access from WUR expires.
- I only need to use it to gather the articles I end up analysing in the thesis. I don't need to put the batch that still needs to go through screening.
- **What should my next steps be? ( Discussion)**
  - Retrieve the articles that pass the first round of screening and put them in the second round which should consist of full-text screening.
  - I also need to work on the eligibility criteria since those that I use now are still very conceptual and would be difficult to argue for at the defence. I can try to make criteria that aim at specific parts of the articles and check for methodological stuff (presence of discussion section, data collection method, social context...)
    - This will require a full round of screening and will take some time, but it is of the utmost priority right now.
  - Once the second round of screening is done and the eligibility criteria consolidated, the next step would be to write down the data collection section of the methodology chapter.

In order to move confidently forward, I will use the adapted search string that I adapted for the meeting, and work with it to retrieve the data for the next round of screening.

## Test string 10:

- **Changes:**
  - I changed the search element eliminating the optimisation, modelling and simulation articles: model\*ing OR simulation OR algorithm\* OR programming OR optimi?ation
  - I eliminated the subject area filters
  - I eliminated the conference paper type of document
- **Scopus version info:**
  - 6/2/2024
  - Database: **Scopus**
  - Searching: TIT-ABS-KEY
  - Language: limited to English
  - Type of document: limited to Article
- TITLE-ABS-KEY ( "peer to peer" OR p2p AND microgrid\* OR "micro grid\*" OR "off W/1 grid" OR "local energy network\*" OR "local electricity network\*" OR ( distributed OR decentrali?ed AND energy OR electricity AND grid OR network\* OR system\*) AND ( energy OR electricity AND trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchang\* ) OR ( "management of" AND "energy supply" OR "electricity supply" ) OR ( energy OR electricity AND "demand management" ) OR ( energy OR electricity W/1 "self consumption" ) OR ( "collaborative consumption of" AND energy OR electricity ) OR "transactive energy" OR "swarm electrification" OR "energy communit\*" AND \*justice OR ( social AND preference OR attitude\* OR right\* OR distributi\* OR allocati\* OR \*connecti\* OR \*divi\* OR \*securit\* ) OR ( social AND value\* OR capital\* OR status ) OR \*equit\* OR \*equal\* OR \*equitab\* OR \*fair\* OR recognition OR acknowledg\*ment OR wealth OR poverty OR polic\* OR legislat\* OR legal\* OR "well being" OR wellbeing

OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR \*ethic\* OR \*accountab\* OR “cross cutting” OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginali\* OR socioeconomic OR "socio economic" OR sociopolitical OR "socio political" OR stratif\* OR cultur\* OR "distributional impact\*" AND NOT model\*ing OR simulation\* OR algorithm\* OR programming OR optimi?ation\* ) AND ( LIMIT-TO ( DOCTYPE , "ar" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )

- **121 results**

- **WoS version info:**

- 6/2/2024
- Database: **WoS**
- Searching: TS
- Language: limited to English
- Type of document: limited to Article

- TS=((“peer to peer” OR p2p) AND (microgrid\* OR “micro grid\*” OR “off the grid” OR “off grid” OR “local energy network” OR “local electricity network” OR ((distributed OR decentralised) AND (energy OR electricity) AND (grid OR network OR system))) AND (((energy OR electricity) AND (trad\* OR swap\* OR purchas\* OR sell\* OR shar\* OR exchang\*)) OR (“management of” AND (“energy supply” OR “electricity supply”)) OR ((energy OR electricity) AND “demand management”) OR ((energy OR electricity) Near/1 “self consumption”) OR (“collaborative consumption of” AND (energy OR electricity)) OR “transactive energy” OR “swarm electrification” OR “energy communit\*”) AND (justice OR injustice OR (social AND ( preference OR attitude\* OR right\* OR distributi\* OR allocati\* OR \*connecti\* OR \*divi\* OR \*securit\*)) OR (social AND (value OR capital OR status)) OR \*equit\* OR \*equal\* OR \*equitab\* OR \*fair\* OR recognition OR acknowledg\*ment OR wealth OR poverty OR polic\* OR legislat\* OR legal\* OR "well being" OR wellbeing OR prosper\* OR access\* OR discriminat\* OR prestige OR reputation OR \*ethic\* OR \*accountab\* OR “cross cutting” OR race OR gender\* OR feminist\* OR ethnic OR advoca\* OR marginali\* OR socioeconomic OR "socio economic" OR sociopolitical OR "socio political" OR stratif\* OR cultur\* OR "distributional impact\*"))

- **99 results**

**OUTCOME OF THE DAY: This string is the final string, so I will work with the articles that are identified through this search string.**

## 7/2/2024 – Search strategy: refining eligibility criteria

### GOAL:

- **The goal for today is to start working on the redefinition of the eligibility criteria, making them more simple and “binary”.**

During the call with Sietze, we discussed the possible new ways to create the eligibility criteria. He suggested to go with criteria based on:

- **Aspects of methodology** – for example: if article deals with methodology of data collection it means its “practical” or if there even is a methodological section
- **Mentions about social actors** – if social actors are not mentioned exclude articles.
- **Social context** – if study does not provide social context, exclude articles

- **Problem statement** – search for the goals of the articles and maybe something comes up. E.g. is there a problem statement?
- **Use of empirical data** – or focus on a running project(s).

Sietze also suggested for me to do a double-phased screening. Move the articles that do not comply with the condition in the TIT-ABS-KEY screening to the second round of screening which would be a full-length screening.

- The goal is to find criteria, that still in the full length screening do not require a detailed reading, but that the method would take about 10–15 minutes max.

## Criteria that are being tested

**Based on real configuration** – vague description. I want reviews about running projects, but if the project is proposed and tested in real life, it works for me as well.

- Analysis of an implemented configuration or analysis of a configuration tested in use?

**Proposals – could be: technical, operational and business solutions.**

- Aims for financial, social welfare or technical optimization and/or improvement are stated in the abstract.
- To include: articles that focus on configurations already operating in the real-world, involve data collection, analysis, and /discussion/interpretation section.
- The article does not report on the real-life employment of said configuration/solution. Testing through software case studies, experimental settings and/or simulation on modelled/hybrid/real-world dataset is not considered as such.

## Struggle with the “proposing solution” criterion

**I still have issues to conceptualise how to disqualify the studies that propose solutions. From those that I’ve read so far from the corpus retrieved from test string 10, the studies seem to vary a lot in their structure, so I decided to ask chat GPT to help me tackle this issue.**

*From ChatGPT*

**Prompt:** “For my thesis, I need to distinguish between different types of studies and academic articles. I only want to work with articles that analyse, report or review projects, case studies, situations and other configurations that operate in the real-world, are already employed. Opposed to those articles, there are some that propose new solutions, design models and methods to create new configurations or to improve the current ones. How can I academically distinguish between these? Please provide me with some academically valid categorisations with criteria.”

**Response:**

*...Analytical Studies vs. Design Studies:*

- *Analytical studies: These articles analyse existing data or information to gain insights into real-world phenomena. They may involve statistical analysis, qualitative analysis, or other forms of data interpretation.*

- *Design studies: These articles focus on creating or designing new configurations, solutions, or methods based on theoretical principles or empirical insights. They often involve the development and evaluation of prototypes, models, or systems.*

*Descriptive Studies vs. Prescriptive Studies:*

- *Descriptive studies: These articles describe and analyse existing phenomena, configurations, or situations in the real world. They aim to provide an understanding of what is currently happening without necessarily suggesting changes or improvements.*
- *Prescriptive studies: These articles propose new solutions, methods, or designs aimed at improving existing configurations or addressing specific issues identified in real-world situations. They often provide recommendations or guidelines for action...*

I think that the description of design studies could be useful for my current situation and needs, and will adopt it as an exclusion criterion. However, I will still need to define it better.

#### **GOAL FOR THE REST OF THE WEEK:**

- **Screen abstracts from string 10 and take notes on the way in which articles include the above mentioned types of criteria.**
  - **What qualifies as “mention” – do I seek direct interaction with the actors/context?**

## **13/2/2024 – Search strategy: refining eligibility criteria**

- I worked with the articles (n=20) that I preselected in the previous rounds and attempts for screening and used them to try out the criteria that I started to develop lately. These are insights and ideas that I got from this process. I started by reviewing the TIT-ABS-KEY again to see if the criteria would allow me to diminish the number of articles that would qualify for a second round of screening.
  - In 7 cases it would require a further inspection to get to know if empirical data are used in the article.
  - 8 articles did not have a clearly defined problem statement in the abstract.
  - 7 articles do not specify the social context of the research.
  - It does not make much sense to screen abstract for the methodology as mostly the articles do not clearly state that in the abstracts.

This experiment taught me that I really need to look for the presence instead of the absence of evidence in the abstract to be able to eliminate a larger number of articles safely from the other round of screening.

**Therefore I decided to screen the whole retrieved batch. I put together the articles retrieved from Scopus and WoS, cleared out the duplicates and got a dataset of 142 articles.** I screened the articles for the presence of proposals of methods/solutions/models to



exclude them, and that proved to be pretty efficient. I still need to finish the screening tomorrow to make conclusions though.

I also noticed that many abstracts do mention social actors such as prosumers, consumers or governments in order to introduce them. This mostly happens with prosumers – my assumption is that the term is still relatively new and therefore the articles need to introduce it and clarify it as soon as possible. However, that does not say anything about the involvement of those social actors in the researched phenomena. I think that this criterion might be a bit misleading for now as in any case the actors only form a part of the framework that I will use for analysis.

## **14/2/2024 – Search strategy: refining eligibility criteria**

Today I finished the screening of the abstracts of the Scopus part of the articles (n=121). I was screening them to sort out articles that completely lack the focus on P2PET and those that are design studies (propose a model/framework/method/solution/improvement).

- I got to remove 66/121 articles based on the design study criterion.

## **15/2/2024 – Search strategy: refining eligibility criteria**

I finished screening the WoS part of the articles. Thus as of now, the corpus should be relatively clean from articles that lack the P2PET focus and are design studies, which leaves me with 47 studies. I still have some question marks at some articles, those will be passed to the second round of screening. The full set of 47 articles will be screened in the second round of screening that includes the full-text reading.

**FOR TOMORROW:**

- Retrieve the 47 articles and start full-text screening.

## **16/2/2024 – Search strategy: refining eligibility criteria**

The retrieval of articles was more complicated than I expected, and it took me almost the whole day to download them. In the end I managed to download 45 of the 47 articles. I was unable to access the remaining 2 articles. I will ask Sietze how to proceed with that.

## 18/2/2024 – Search strategy: refining eligibility criteria

Today I started the second round of screening. I checked for the following aspects:

- Whether the articles do have a methodology section
- Whether the articles specify the data collection method
- What type of data the articles work with
- Whether the articles have a discussion section
- Whether the articles specify the social context of the research

I also read through the articles that I was not sure whether they were a design study.

**INSIGHT:** Some of the articles do not have a methodology section per se, but the methods used are explained in the introduction or elsewhere in the articles. How should I approach that regarding the setting of criteria? Also other articles do have a methodological section, but the information there is rather vague and does not specify things about the research activities and approach of the research.

## 19/2/2024 – Search strategy: refining eligibility criteria

Continuing the 2nd round of screening.

- I still need to check if the papers I work with are peer-reviewed. I just learnt that All articles on Scopus and WoS are not necessarily peer-reviewed, so I still need to check that.
  - To do that, I need to check the publication process of the journals that published my articles.

**FOR TOMORROW:**

- **Finish the 2nd round of screening.**

## 20/2/2024 – Search strategy: refining eligibility criteria

Today I finished the second round of screening and prepared for the meeting with Sietze I had today in the afternoon. I tried to make some quick conclusions about the articles that I screened, but after the meeting, I think I will need to take a second look at the articles to be 100% sure that the eligibility criteria work well and that the conclusions are valid.

## Meeting with Sietze:

- We discussed the use of the concept “design study” as an exclusion criterion. Sietze liked it, but we encountered the issue that usually the studies do not call themselves “design studies”, therefore I will need to specify that and maybe alter it a bit. Sietze proposed to use the term “design-oriented studies” instead. I will need to look into that further.
- I also asked about the validity of excluding articles I cannot access. Sietze advised me to send an email to the library and ask if they can retrieve it for me. If not, I can either make that into an eligibility criterion – articles have to be accessible online, or comment on this limitation in my methods section.
- We also discussed the issue with vague methods sections of screened articles or the presence of information about methods in other parts of the articles. Sietze advised me to adapt my eligibility criterion from “presence of methods section” to something more specific such as “specification of research methods and research activities, data collection methods is present and explained”. I will have to incorporate that.
- According to Sietze, there is no minimum number of articles to conduct a SLR, therefore I do not need to stick with the minimum number of 30, I just have to be very transparent and document and argument well on my selection process.
- For the next meeting I should finish the selection of articles for analysis and look into the codebook development and think about the analysis method.

## 22/2/2024 – Search strategy: refining eligibility criteria

### GOAL:

- **Collect and define all the criteria that I want to use to exclude/include articles.**
- **Update the search strategy document accordingly.**
- **Create a Prisma flowchart diagram of my articles inclusion process.**

### OUTCOME:

- **I managed to define the criteria and update the search strategy document. I also finished cleaning up the excel sheet (A.2 Articles Overview: Selection and Screening Sheet).**
- **I wrote the first draft of the data collection and screening process description that I will include in the search strategy document that I want to send to Sietze tomorrow.**
- **I did not manage to create the Prisma flowchart diagram as I still need to double check the articles that passed the first round of screening to confirm whether the formalisation of the search criteria has not affected the outcome of the second round. I will do that tomorrow and then use the numbers for the diagram.**

**Response from library:** I got an e-mail from the WUR Library saying that they cannot source the articles for me, therefore I will exclude them.

# Eligibility criteria

## General filters:

- **Peer-reviewed academic articles**
  - Only academic articles published in a peer-reviewed journal are eligible for analysis.
- **Articles in final stages of publication**
  - Articles eligible for analysis must be accepted for publication or already published by a journal. Thus only articles with the “published” or “in press” status are eligible.
- **English**
  - Given the language skills of the researcher, articles eligible for analysis must be written in English.
- **Accessible online for free with my institutional access**
  - Articles eligible for analysis must be accessible online as open access articles or available through the institutional access provided by WUR.

## Design-oriented articles

- Design-oriented articles are excluded from the analysis. As design-oriented are understood articles that do not aim to study the current real-world configurations in order to gain new knowledge, but rather aim to design, propose or introduce technical solutions or improvements, optimisation, pricing or business models, frameworks and methods, etc. Given that the aim of this research is to study the empirical configurations, such articles are excluded from analysis.
- To this end, keywords referring to programming, optimisation, simulation, and modelling are used to form the restrictive search element in the search strategy. The reason behind this decision stems from the iterative process which uncovered that the majority of design-oriented articles come from those research fields and activities.

## P2PET focus

- Given the focus of the research, the P2PET focus is an inclusion criterion. To include an article based on this criterion both of the following conditions need to be met:
  - The article does explicitly focus on studying the P2P configurations.
  - The P2P configurations that are studied in the article are directly linked to the act of energy trading. This includes configurations that enable, constitute, regulate or oversee the trading of energy. A broad understanding of the term “trading” is used including sharing, swapping, exchange and similar activities of collaborative energy consumption and management.

## Description of research and data collection methods

- All articles eligible for analysis are required to include a description of research and data collection methods.

## Use of empirical data (primary and secondary) but not curated/simulated data

- Articles eligible for analysis are required to conduct analysis of empirical data (primary and/or secondary). Studies working with simulated, modelled or estimated data are not included for analysis.

## FOR TOMORROW:

- **Double check the second round of screening to confirm the criteria hold.**
- **Create Prisma flowchart.**
- **Research about how to write about the data collection and screening process in the thesis.**

## **23/2/2024 – Search strategy: refining eligibility criteria**

### **GOAL:**

- **Double check the preselection of articles**
- **Create Prisma flowchart**
- **Research about methods section writing – check the SLR from the corpus**

### **Double checking preselection notes:**

Should I distinguish between study design, methodology for data collection and analysis methods/framework? How to define that well in the criteria?

### **OUTCOMES:**

- **I managed to create the flowchart and the final preselection of the articles and I've sent that part to Sietze.**
- **I did not research the methods section writing.**

## Appendix C: Codebook

Construct name	Definition	Description	Initial code 1/2	AND/OR	Initial code 2/2
<b>Distributional justice</b>	<p>“Distributional justice recognises both the physically unequal allocation of environmental benefits and ills, and the uneven distribution of their associated responsibilities. (...) Distributional justice concerns not only the siting of infrastructure, but access to energy services too.” (Jenkins et al., 2016)</p>	<p>I look for the mentions about availability, accessibility and affordability of the energy services due to the physical distribution of the infrastructure and access to energy services.</p>			
			<p>availability – availability indicates the feasibility of establishing P2PET infrastructure and services</p>		<p>physical infrastructure</p>
			<p>accessibility – accessibility indicates the opportunity of those in a particular geographic location to access the P2PET and its associated services</p>		<p>services</p>

			affordability – indicates the capacity of whole populations and sections therein to afford P2PET energy services		energy
<b>Justice as recognition</b>	Recognition justice (...) states that individuals must be fairly represented, that they must be free from physical threats and that they must be offered complete and equal political rights.	I look for mentions of cultural domination, non-recognition, and disrespect regarding the access and use of the energy infrastructure and services.			
			cultural domination		
			non-recognition		
			disrespect		
<b>Procedural justice</b>	Procedural justice concerns access to decision-making processes that govern the distribution of infrastructure and services and the recognition of the rights of people to	I look for mentions of rights, responsibilities and recognition of individuals, groups, and entities regarding the decision-making process.  “It has been thereafter			

	use it. It manifests as a call for equitable procedures that engage all stakeholders in a non-discriminatory way.	applied to class, gender and religion. Procedural justice is underpinned by access to and pressure from multi-level legal systems.” (Jenkins, 2016)			
			Rights		practices
			Responsibilities		norms
			Recognition/representation in decision-making		values
					behaviours
					legal regulations
					class
					gender
					religion