The Stories of User Flexibility

An Exploration of Flexibility Capital for a Just Energy Transition

Libertson, Frans

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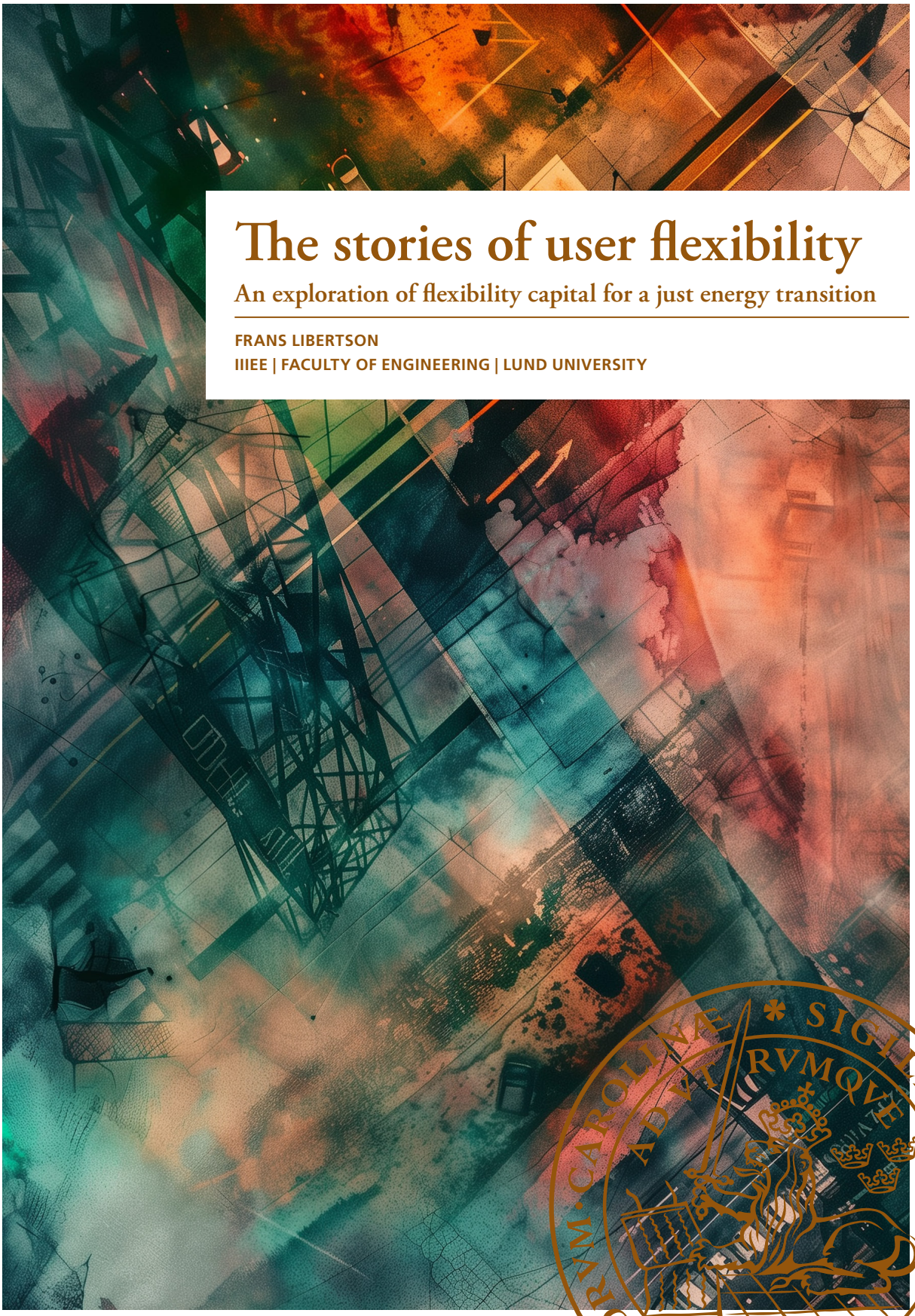

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An exploration of flexibility capital for a just energy transition

FRANS LIBERTSON
IIIEE | FACULTY OF ENGINEERING | LUND UNIVERSITY

The stories of user flexibility

The pending ecological crisis has ushered in a need to rethink how electricity is produced and consumed, which in turn will require new ways of maintaining system balance. One solution that has gained traction over the past decade is the idea of user flexibility. User flexibility is by some deemed integral to the transition towards a low-carbon society and to the decarbonization agenda, and its integration is commonly motivated by economic, systemic, and environmental arguments. However, user flexibility has also received critique for potentially contributing to energy injustices, and the way in which user flexibility will be implemented may or may not result in an unjust energy transition.

Frans Libertson blends science, fiction, and art in this thesis to explore how user flexibility is understood by various stakeholders and made sense of within the transition to a low-carbon society. By looking at the ways in which user flexibility affects aspects of daily life, Frans also considers its energy justice implications.

Flexibility blurs the lines between labour and behaviour, public and private, work and leisure. Scrutinizing these effects should provide warnings about enrolling users in flexible energy consumption schemes and encourage questions about whether it is right to instrumentalize people and their behaviours to uphold socio-technical systems, particularly if the aim of these systems is to generate profit.

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Frans Libertson

LUND
UNIVERSITY

DOCTORAL DISSERTATION

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Abstract:
The pending ecological crisis has ushered in a need to rethink how electricity is produced and consumed, which in turn will require new ways of maintaining system balance. One solution that has gained traction over the past decade is the idea of user flexibility. User flexibility is by some deemed integral to the transition towards a low-carbon society and to the decarbonization agenda, and its integration is commonly motivated by economic, systemic, and environmental arguments. However, user flexibility has also received critique for potentially contributing to energy injustices, and the way in which user flexibility will be implemented may or may not result in an unjust energy transition.

This thesis aims to understand the potential energy justice pitfalls of user flexibility by looking at the ways in which it affects certain aspects of everyday life. This is done in part by a conceptualization that draws on existing literature for understanding flexibility capacity, but also by adding empirical rigour to the understanding of how user flexibility affects certain aspects of everyday life as well as how various stakeholders (public news media, industry experts, electric vehicle users) characterize key themes associated with user flexibility.

This thesis applies the concept of flexibility capital as a theoretical framework for analysis, which is a concept that understands the capacity to be flexible in the use of electricity as the outcome of a set of material, social, and temporal factors. Overall, the findings display a discrepancy between how user flexibility is characterized publicly (by the media, industry experts, and electric vehicle users) and how it is characterized by the energy justice literature. User flexibility is commonly associated with decarbonization and sustainability in the media, and industry experts and electric vehicle owners tend to characterize user flexibility as a means of increasing the share of renewables in the energy mix, a more economical option for building new infrastructure, a means of facilitating more efficient uses of the existing infrastructure and for balancing the system, and a more democratic form of electricity consumption. Concurrently, analysing user flexibility from an energy justice perspective, this thesis identifies several potential energy justice implications. User flexibility based on market principles may cause 1) an unequal redistribution of wealth, 2) a redistribution of economic responsibility to the end-users, 3) unequal terms of participation, 4) already affluent users to benefit, 5) increased complexity in a manner that is particularly disadvantageous for non-involved users, and 6) diluted transparency and accountability. The gap between the depiction of user flexibility among stakeholders vis-à-vis the scientific literature on energy justice provides further evidence for how energy policies are primarily informed by economics and technology.

In conclusion, the findings of this thesis showcase the need for integrating more social perspectives in energy policy in order to avoid potential energy justice pitfalls. The findings also underline the benefits of exploring non-financial and non-market-based incentives for facilitating user flexibility.

Key words:
Just energy transitions; energy justice; flexibility capital; socio-technical narratives; storytelling

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To my parents – who read to me
the stories that inspired me to write

flexibility*

noun

/ˌflek.səˈbɪl.ə.ti/

the ability to change or be changed easily according to the situation

the ability to bend or be bent easily without breaking

readiness to yield to influence or persuasion

* definition according to Cambridge Dictionary (n.d.) and Oxford English Dictionary (n.d.)

Table of Contents

Abstract

The pending ecological crisis has ushered in a need to rethink how electricity is produced and consumed, which in turn will require new ways of maintaining system balance. One solution that has gained traction over the past decade is the idea of user flexibility. User flexibility is by some deemed integral to the transition towards a low-carbon society and to the decarbonization agenda, and its integration is commonly motivated by economic, systemic, and environmental arguments. However, user flexibility has also received critique for potentially contributing to energy injustices, and the way in which user flexibility will be implemented may or may not result in an unjust energy transition.

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involved users, and 6) diluted transparency and accountability. The gap between the depiction of user flexibility among stakeholders vis-à-vis the scientific literature on energy justice provides further evidence for how energy policies are primarily informed by economics and technology.

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Popular Science Summary

This thesis can be used by policymakers and industry experts who want to learn more about the potential energy justice implications linked to user flexibility. The thesis examines potential energy injustices by exploring how user flexibility may affect the everyday lives of energy consumers. The thesis also examines how user flexibility is portrayed in the media, and how different actors such as industry experts and electricity consumers understand the concept of user flexibility. The study draws on data from both interviews and surveys in Sweden.

Energy sectors worldwide are currently facing major challenges and substantial changes. Climate change calls for a transition to a low-carbon society, while various technological and economic trends are influencing the development of future energy systems. Integrating more renewable energy means rethinking and reimagining how energy is produced and consumed.

Renewable energies are unique in that their production is more intermittent and volatile than conventional power sources. For example, solar power cannot produce energy during night and wind power is not efficient in calm weather. This means that as long as there are no viable solutions for storing large amounts of energy, the use of energy will have to be adapted to the available supply.

A possible solution to better balance supply and demand under these conditions is user flexibility. Essentially, user flexibility means that consumers modify their consumption of energy and relocate it to times of the day when the demand is low. In so doing, consumers can provide system benefits that maintain the system balance and avoid overloading the grid. The incentives for encouraging consumers to be more flexible are often imagined in financial terms. By compensating consumers economically, they are expected to be more flexible in their energy use.

However, user flexibility has also been criticized for contributing to energy injustices, and the way in which user flexibility will be implemented may or may not lead to an unjust energy transition. The criticism is based on the idea that the ability to be flexible depends on a range of economic, material, social, and temporal factors that are unique to the consumer. For example, more affluent consumers have more economic means to invest in smart technologies that better can provide user flexibility, and consumers with jobs that do not tie them to a specific location and time of day can to a greater extent arrange their days (and energy use). Hence,

rewarding consumers economically for their flexibility entails an inherent injustice, as some consumers are better equipped to be flexible in their energy use than others.

Based on the findings of the thesis, three main conclusions can be made: 1) several potential energy injustices exist in the development of user flexibility, 2) there are several benefits of also including social perspectives in the analysis of the impacts of user flexibility on consumers, and 3) the absence of social perspectives in the understanding of user flexibility by several actors demonstrates the need for including more social perspectives in energy policy.

The analysis of the results shows that user flexibility based on market principles risks causing five potential energy injustices. The first injustice risk is that user flexibility may contribute to an unequal redistribution of wealth. Since affluent consumers tend to have the most capacity to contribute with user flexibility, they will be the main beneficiaries of such an approach. The second injustice risk is that the energy system may cause an unequal redistribution of the economic costs of the investments in the system infrastructure. The third injustice risk relates to unequal participation. Since participation will be conditioned by economic and material resources, the opportunities for participation will also be unique to each consumer which will mainly benefit wealthy consumers. The fourth injustice risk relates to the fact that more user flexibility will increase system complexity and make it more difficult to understand the system, which will particularly disadvantage third parties. The fifth and final injustice risk relates to transparency and accountability. The more actors involved in maintaining system functions, the greater the risk that the system may be less transparent to third parties, and the distribution of responsibilities may become unclear.

The analysis of the results also shows that there are advantages to including social perspectives in the analysis of user flexibility. Analysing user flexibility based solely on economic principles risks giving a one-sided and simplified picture. By understanding the ability to be flexible as a result of individual resources and capacities, the individual conditions for being flexible and how consumers can either benefit or be disadvantaged by a system are also clarified.

Lastly, the analysis of the results also shows that it is mainly technical and economic perspectives that are raised in the public media discourse and among different stakeholders. Social perspectives that highlight justice implications are rare or never heard. Therefore, in order to reduce the potential risks associated with user flexibility, social perspectives should be given more attention in energy policy and related issues.

List of Papers

Paper I

Libertson, F. (2022). (No) room for time-shifting energy use: Reviewing and reconceptualizing flexibility capital. *Energy Research & Social Science*, *94*, 102886. https://doi.org/10.1016/j.erss.2022.102886

FL was responsible for conceptualization, methodology, data collection, data analysis, writing the manuscript, and revision of the article.

Paper II

Libertson, F. (2021). Competing socio-technical narratives in times of grid capacity challenges: The representative case of Sweden. *Energy, Sustainability and Society*, *11*(1), 1–13. https://doi.org/10.1186/s13705-021-00279-4

FL was responsible for conceptualization, methodology, data collection, data analysis, writing the manuscript, and revision of the article.

Paper III

Libertson, F. (2024). Misalignments of theory and practice: Exploring Swedish energy utilities' understandings of energy justice, flexibility capital and just energy transitions. *Energy Research & Social Science, 111,* 103471. https://doi.org/10.1016/j.erss.2024.103471

FL was responsible for conceptualization, methodology, data collection, data analysis, writing the manuscript, and revision of the article.

Paper IV

Libertson, F. (2022). Requesting control and flexibility: Exploring Swedish user perspectives of electric vehicle smart charging. *Energy Research & Social Science*, *92*, 102774. https://doi.org/10.1016/j.erss.2022.102774

FL was responsible for conceptualization, methodology, data collection, data analysis, writing the manuscript, and revision of the article.

Acknowledgements

The trials and tribulations of my PhD journey started long before I was hired. Upon graduating from Lund University with a Master of Science, I set my sights on an academic career. Little did I know how challenging it would prove to become admitted as a doctoral student. At some point, I lost count of the number of times I had been shortlisted but fallen short, and after over three years of trying and failing, I was ready to give up. Then along came an opening at the International Institute for Industrial Environmental Economics ('Insti'), and I decided to give it one final go…

I am forever indebted to my supervisors Jenny Palm and Lena Neij for believing in me and for giving me a chance at earning my PhD. I don't think you realize exactly how much this opportunity has meant to me, and I am incredibly thankful for the journey that you offered me. I am deeply grateful for your constant support, encouragement, and mentorship. Over the course of my four years at Insti, you've been an invaluable source of support, always dependable and ready to lend a hand when I needed it.

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Going on a journey usually involves visiting new and exciting places and meeting interesting and inspiring people. My PhD journey was no different. I want to extend my sincere appreciation to all the fantastic people that I have met in projects, courses, PhD schools, and conferences. Your input and support have been crucial to my journey, and I could not have done it without your help. Special thanks to Peder

and Maja of the CLUE project, Hannes at LTH, Sofie at KTH, and Hanna at RISE for always lending me your expertise.

During my doctoral journey, I have also had the privilege of experiencing first-hand the intricate connections of body and mind, both as mental and as physical practices. To my research findings, I can also add empirical evidence supporting the notion that the mind cannot exist without the body, and vice versa. My love for yoga is no secret, and it's undeniable that my PhD journey would not have been possible without the help of my magical yoga studio. Hot Yoga Malmö – what would I do without your vibrant space? You have offered me a sanctuary amidst the rigours of academic life. My heartfelt gratitude goes to all the lovely people at Hot Yoga Malmö for keeping me grounded and well.

Long journeys commonly require extensive planning. Fortunately, my parents prepared me in the best possible ways. They showed me the fantastical worlds of fiction and taught me the value of reading and writing. This thesis is a reflection of my upbringing as much as it is the result of four years of doctoral studies, and it would have looked very different had it not been for my parents. I am eternally grateful for everything that they have given me.

If luck has it, journeys may also include adventures. I have been blessed with a group of fantastic friends who have enriched my doctoral journey with excitement, wonder, and madness. Big props to Captain, Big-D, and A-Man for being my partners in the epic adventure of life and for giving me well-needed mental escapes from work. Your friendship means the world to me.

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Frans Libertson

Lund, Sweden
April 2024

Preface

What does it mean to be flexible? According to the Cambridge Dictionary, flexibility is the ability to change or be changed easily according to the situation. Alternatively, it is the ability to bend or be bent easily without breaking. The Oxford English Dictionary adds that flexibility is the readiness to yield to influence or persuasion. In colloquial terms, flexibility undoubtedly has a positive connotation. Is there anyone who wishes they were surrounded by stiff, ridged, or unchangeable people, let alone be such a person themselves? It probably sounds a lot more appealing to be someone accommodating and agreeable, and to be someone who can adapt according to the context or the situation. Being flexible is a skill that is rewarded in society. Modern workplaces promote agility, flexible employment, and flexibility in organizational culture; educational institutions are increasingly emphasizing flexibility in teaching and learning; health and wellness programs promote physical flexibility to prevent injuries and increase overall well-being; and technological innovations have made communication, work, and entertainment possible whenever and wherever.

In this thesis, I investigate flexibility in energy systems. Flexibility has always been the fundamental component that maintains the balance between supply and demand. Historically, flexibility has primarily been a feature of energy production, but in conjunction with the introduction of renewable energy the function of flexibility is being shifted to energy consumption. Instead of maintaining balance by adjusting the supply of energy to accommodate the demand, energy consumers are asked to adapt and shift their consumption to comply with production by providing what is called user flexibility.

Similar to how flexibility is promoted in other societal sectors, user flexibility is often presented as something desirable and as an opportunity for energy consumers. With this thesis, I want to bring some nuance to this picture. I believe that user flexibility under certain conditions could potentially bring about a more sustainable energy system. But I also believe there are reasons to be concerned. With these presumptions as a backdrop, I explore the potential energy justice implications of user flexibility and the ways in which user flexibility is understood by various stakeholders and made sense of within the energy transition towards a low-carbon society. This exploration takes two forms: a conventional doctoral dissertation and a fictional story.

When writing this thesis, I decided to add a story of my imagination to honour my love for storytelling and all the stories that have inspired me to write. I call it a fictional abstract. It is my hope that presenting my research as a story will make the thesis more accessible to a general audience. The fictional abstract should not be regarded as a complete summary of the thesis, but rather as the essence of the thesis captured in the format of a story. This work of fiction is called 'Bartleby, the Consultant: A Story of Flexibility', and it serves both as a depiction of a society where people are increasingly expected to be flexible to maintain system balance and as a personal reflection on my work.

'Bartleby, the Consultant: A Story of Flexibility', is a paraphrase of the famous short story 'Bartleby, the Scrivener: A Story of Wall Street' by Herman Melville (1819-1891). Melville's story depicts a Wall Street lawyer who hires Mr. Bartleby as a clerk to do his menial tasks. The lawyer is at first very satisfied with the recruitment, but after a period of producing high-quality work Bartleby suddenly starts refusing every task he is given with the words: 'I would prefer not to'. Several interpretations of Melville's story and its themes have been made, such as a depiction of depression, an exploration of free will, and a representation of passive resistance. However, the themes that I would like to emphasize are those of alienation, isolation, and compliance. These themes are present in both Melville's and my story; however, my adaptation deviates in one major aspect. In Melville's story, Bartleby says 'no' to everything in an attempt to resist the system. In my iteration, his namesake says 'yes' to everything in his attempts to comply with the system, even when he does not fully understand the reasons for it or when it is against his interest.

Every chapter in the thesis is introduced with a snippet from the fictional abstract. Thus, the dissertation and the fictional abstract can be read in parallel or separately, depending on the flexibility of the reader. Regardless, I hope that they provide inspiration, food for thought, and entertainment.

Bartleby, the Consultant: A Story of Flexibility

1.

B. Bartleby was labouring away at this desk. Mr. Bartleby was a very dedicated employee and he prided himself on his high work morale. He was always the first person to arrive at the office in the morning and every evening he was the last to leave. Mr. Bartleby worked for William Rooster – a self-made gentleman who, like so many other contemporary self-made gentlemen, had inherited his fortune from his parents. Mr. Rooster was a very caring employer, and as such he had equipped the office space with both a ping pong table and an espresso machine. Mr. Rooster very badly wanted his employees to feel like a family, but what he wanted the most was to make Rooster Consultancy Inc. renowned.

Mr. Bartleby had been hired as a software developer, although in reality, his work entailed very little actual development. Most of the time he was instead tasked with monitoring test runs and correcting occasional coding errors. One month into his employment, Mr. Bartleby was about to complete another test sequence when Mr. Rooster approached his desk…

1 User flexibility and the energy transition

In this thesis, I will explore the potential energy justice implications of user flexibility by looking at the ways in which it affects certain aspects of everyday life. In doing so, I will also explore how user flexibility is understood by various stakeholders and made sense of within the energy transition towards a low-carbon society.

The pending ecological crisis has ushered in a need to rethink how electricity is produced and consumed, which will in turn require new ways of maintaining system balance (Hojčková et al., 2018). One solution that has gained traction over the past decade is the idea of user flexibility (Calver & Simcock, 2021; Lo Piano & Smith, 2022; Lund et al., 2015). In this scenario, end users accommodate energy imbalance by modifying their consumption of electricity in intensity, time, or space (Grunewald & Diakonova, 2018; Powells et al., 2014; Powells & Fell, 2019). Historically, maintaining energy balance has been the responsibility of the supply side, which has meant that production has been ramped up when demand has been high and ramped down when demand has been low (Grunewald & Diakonova, 2018). However, incorporating more user flexibility would mean that the demand side would adjust consumption according to the available supply, rather than vice versa, so shifting much of the responsibility for maintaining system balance onto consumers (Kubli et al., 2018). Some consider user flexibility integral to the transition towards a low-carbon society and to the decarbonization agenda (Blue et al., 2020), and its integration is commonly justified with the following economic and technological arguments.

The first argument refers to the challenge of ***decarbonizing the production of electricity***. Decarbonizing production entails a shift away from fossil-fuel dependent and non-renewable means of electricity production towards renewable energy sources. However, the current centralized structure of the electricity system is optimized for accommodating a constant baseload from conventional power sources such as coal and nuclear power plants (Wright, 2018). The volatile and decentralized nature of renewable energy sources such as wind and solar power will complicate maintaining the energy balance and voltage regulation (Svenska Kraftnät, 2015). In essence, integrating renewables will require more adaptation of consumption to fit the new load profile of the supply side (Adams et al., 2021). Ergo, user flexibility.

The second argument refers to the challenge of ***decarbonizing the consumption of electricity***. Societal sectors like the transportation sector that were previously powered by fossil fuels will soon be electrified, resulting in a massive increase in the demand for electricity and an entirely new load profile on the demand side. It is estimated that the global electricity demand will more than double by 2050 (IEA, 2023). Adding to this vast increase will be the emergence of new, energy-intensive industries such as the data centres that will likely come as a result of the digitalization of society (Di Silvestre et al., 2018). This change in demand will require a more efficient form of electricity consumption (Lund et al., 2015). Ergo, user flexibility.

The third argument refers to ***economic considerations as regards future investments***. Around the globe, transmission lines and production facilities are approaching the end of their useful life span (Hojčková et al., 2018). Building new infrastructure is extremely expensive, and so engineers and policymakers are exploring less costly alternatives. Rather than expanding the capacity of existing transmission lines to accommodate new load profiles, a much cheaper option is to use the existing infrastructure more efficiently by adjusting the load through more flexible use of electricity that avoids overloading the grid (Bradley et al., 2013). Ergo, user flexibility.

The fourth and final argument for more user flexibility relates to ***concern about the physical environment.*** Avoiding the construction of new infrastructure offers both economic and environmental benefits. More efficient use of existing infrastructure will avoid additional resource use (and the associated carbon emissions) and the damage to the physical environment that the installation of new infrastructure entails (Calver & Simcock, 2021; Martínez Ceseña & Mancarella, 2018). Ergo, user flexibility.

Facilitating user flexibility is commonly discussed in terms of financial incentives. In exchange for a financial reward, the end user is incentivized to modify their consumption of electricity. By use of hourly tariffs and pricing signals, the user will be informed of the times when it is a good time to use electricity and when use should be avoided (Smale et al., 2017). Alternatively, the incentives could involve direct payments to end users in exchange for flexibility (D'hulst et al., 2015) or non-financial motivations such as community-based social marketing (Anda & Temmen, 2014).

Technological solutions that enable user flexibility are commonly envisaged as working in three ways: 1) manual load control, where users manually alter their consumption in response to external signals; 2) direct load control, where an external operator remotely controls consumption via smart appliances; and 3) automated load control, where smart technology autonomously controls consumption in response to external signals (Smale et al., 2017).

In sum, in light of the imminent ecological collapse that requires adaptations to climate change and a transition to a low-carbon society (Hojčková et al., 2018), user flexibility offers a cost-effective means of integrating a higher proportion of renewable energy production while also facilitating a more resource-efficient form of consumption (Bradley et al., 2013). These ideas have made user flexibility an integral component of the decarbonization agenda (Blue et al., 2020). However, the general approach to implementing user flexibility has been criticized for being too focused on economics and technology while overlooking its implications for energy justice (Calver & Simcock, 2021; Powells & Fell, 2019; Smale et al., 2017). In this thesis, I aim to address these potential energy injustices, and in doing so contribute to the growing field of energy research and social science.

Before proceeding further, I would like to address the terminology. Terms such as demand-side management (Adams et al., 2021), demand-side response (O'Connell et al., 2014), time-of-use tariffs (Torriti, 2012), and shift consumption (Jalas & Numminen, 2022) are all used for denoting user flexibility. Throughout this thesis, I will be using user flexibility as an umbrella term if nothing else is stated. The reason behind this lexical choice is that I want to place users and their capacities at the centre of this study and the social implications of shifting electricity uses.

1.1 The case of Sweden

Sweden is in many respects representative of a Western industrialized country with a centralized energy sector (International Energy Agency, 2019) in the midst of a transition to a low-carbon society. Concurrently, Sweden also contains certain elements related to its production and consumption of electricity that render it an interesting case for investigation.

At the national level, Sweden performs well in terms of electricity production and minimizing carbon emissions. Electricity production is more or less fossil free (Energiföretagen & Fossilfritt Sverige, 2020; Swedish Energy Agency, 2019), and Sweden is said to be leading the way towards a low-carbon society (International Energy Agency, 2019), although the climate policies of the new government may change this evaluation (Swedish Climate Policy Council, 2023). The country has a yearly net surplus of electricity production, and was in fact the largest exporter of electricity in all of Europe in 2022 (Zachrisson Winberg, 2023). Concurrently, at the regional level, certain areas in Sweden are experiencing transmission problems. Old transmission lines and the decommissioning of local and regional production facilities, in combination with a growing demand for electricity, have resulted in grid congestion and transmission bottle-necks in the most urbanized areas (Svenska Kraftnät, 2017, 2018).

Like other Western industrialized countries, Sweden is anticipating a vast increase in the demand for electricity in coming years. Estimates predict a 50% increase by 2045 (Fossilfritt Sverige, 2023), which poses challenges for how Sweden shall ensure its production and transmission of electricity in the future. The issue is further exacerbated by the country's geography and the constitution of its electricity system. Most of the production facilities are in northern Sweden, while most of the consumption occurs in southern regions. Due to the long latitudinal distances of Sweden, this configuration requires vast amounts of transmission lines which quickly become overloaded when the demand in the south increases (Byman et al., 2016).

The mismatch of supply and demand has resulted in grid congestion and transmission constraints, which have affected local communities (Libertson et al., 2021). For example, several local and regional businesses in the county of Skåne have been compelled to halt their expansion plans due to the electricity shortfall (Capuder, 2019; Hugoson, 2019; Lärka & Ekhem, 2019). Infrastructural projects, such as the harbour at Ystad and regional rail infrastructure, have also been affected by the grid congestion (Boström & Jähnke, 2019; Magnusson, 2018). Similar issues have been reported in the cities of Stockholm (Stockholms Handelskammare, 2020), Uppsala (ÖMS, 2020b) Västerås (ÖMS, 2020a), and Gävleborg (Jansson, 2019) where the transmission of electricity is also constrained by grid congestion.

The electricity system of Sweden clearly needs to be modernized in order to ensure its future production and transmission of electricity. Not surprisingly, user flexibility has been proposed as an option for addressing the challenges of grid congestion and the looming increase in demand that necessitates a more efficient consumption (Power Circle, 2022). In fact, in 2022 the Swedish government mandated that flexibility should become a part of the national electrification strategy (Uppdrag Att Främja Ett Mer Flexibelt Elsystem [Mandate to Promote a More Flexible Electricity System], 2022). Thus, Sweden constitutes an interesting case for exploring how the development of user flexibility is understood, and how its implementation may give rise to potential energy injustices.

1.2 Problem formulation

The ways in which user flexibility is currently being developed and implemented have been criticised for being too focused on economics and technology (Blue et al., 2020) while failing to consider the potential energy inequity implications of current policies and the general framing of user flexibility (Calver & Simcock, 2021; Powells & Fell, 2019; Smale et al., 2017). Research has shown that contemporary energy policies tend to be informed primarily by science, technology, engineering, and mathematics (Ingeborgrud et al., 2020). This narrow focus ignores the long-

term implications systems of electricity provision have for everyday life, as well as how they may or may not contribute to energy justice (Sovacool et al., 2016). It has also affected how industry experts frame and understand user flexibility (Adams et al., 2021). Users are assumed to be driven by purely economic rationality when providing flexibility, without any consideration to the specific needs that drive electricity use (Kaviani et al., 2023). Instead, electricity use is commonly understood as inherently flexible, and providing flexibility is framed as a purely economic matter (Blue et al., 2020). However, this understanding of user flexibility overlooks how the capacity to be flexible is often the outcome of a set of material, technological, social, and economic factors (Powells & Fell, 2019), and how providing flexibility also comes with non-monetary costs (Grunewald & Diakonova, 2018). Seen from this perspective, providing flexibility may become a matter of socio-economic status, and thereby also an energy justice issue, as it may entail that users participate on unequal terms.

The energy transition will inevitably have vast implications for society. How these changes to the energy sector are implemented, such as the application of user flexibility, will determine how the costs, risks, benefits, and burdens of the transition are distributed (Carley & Konisky, 2020; Fell, 2019). Thus, it is crucial that user flexibility programmes be evaluated not only from a technological and economic perspective, but also from the outlook of critical social science to account for any type of energy justice implication (Calver & Simcock, 2021; Smale et al., 2017).

Based on previous research asserting that technology has the potential to not only contribute to environmental sustainability, but also to exacerbate energy injustices (Heffron et al., 2020), I have arrived at the following problem formulation:

> An electricity system that relies on the flexibility of its users to remain operational risks creating a more unjust energy transition.

1.3 Research gap

Ideally, research should not be done in a vacuum but should seek to contribute to our collective understanding of the world. My goal with this thesis is to address the following research gaps: 1) the potential implications of user flexibility for energy justice, 2) the potential implications of user flexibility for certain aspects of everyday life, and 3) the existence of energy injustices in Sweden pertaining to electricity consumption.

Human-made systems, such as systems of electricity provision, are inextricably linked to modes of governance (Sadowski & Levenda, 2020) which means that social hierarchies of power are built into and intrinsic to the systems (Burke & Stephens, 2018; Healy & Barry, 2017; Newell & Mulvaney, 2013) Thus, in order to

fully understand and evaluate the implications of electricity systems, they should be assessed holistically. More specifically, the scrutiny of systems of electricity provision should account not only for their technological performance or their economic values, but also for how well they mitigate or uphold hierarchies of power and unjust social orders (Heffron et al., 2015; Heffron & McCauley, 2017).

The ways in which electricity is produced and consumed have profound effects on society. They have been associated with a wide range of energy justice issues, including unequal access, land grabbing, disenfranchisement, displacement, and pollution (Baker et al., 2019). For example, building the new infrastructure for renewable energy production requires rare earth minerals, the mining of which is associated with environmentally harmful practices (Navarro & Zhao, 2014). Similarly, the locations chosen for renewable energy facilities have resulted in the displacement of people (Avila-Calero, 2017) and environmental destruction (Guðmundsdóttir et al., 2018). Yet other examples include how nuclear power production unevenly distributes its benefits and burdens in society (Jenkins, Heffron, et al., 2016).

While user flexibility does offer potential benefits in relation to decarbonizing society, the lack of research on its potential disadvantages should advise caution (Milchram et al., 2020). Given the many examples of how the design of electricity systems has disproportionately affected certain groups (e.g. Ribó-Pérez et al., 2021; White & Sintov, 2019), user flexibility should not be included in decarbonization strategies without critical examination. More research is needed on how providing flexibility impacts users and how user flexibility distributes benefits and burdens among its stakeholders (Calver & Simcock, 2021; Crawley et al., 2021). This is the first research gap I have aimed to address.

The second research gap relates to the lack of understanding of users and of different types of electricity uses. End users constitute a diverse group with different needs, capabilities, and vulnerabilities (Fell et al., 2023; Ribó-Pérez et al., 2021). Consequently, different users will have different opportunities for providing flexibility, and the expectation of user flexibility will affect different users differently (Calver & Simcock, 2021; Powells & Fell, 2019). There is also a general lack of understanding within the energy sector of how uses of electricity are related to daily activities, and of how changes will affect everyday life (Kaviani et al., 2023). The use of electricity is often assumed to be inherently flexible, without any consideration of temporal, cultural, social, or economic limitations (Blue et al., 2020). However, the demand for electricity and the flexible uses of electricity cannot be fully understood if they are not seen within the entanglement of everyday routines that constitute daily life (Oliveira et al., 2023; Ruotsalainen et al., 2017). Consequently, more research is needed on the complexity of providing flexibility and the conflicts that may arise between the technical and the social dimensions of providing flexibility (Lo Piano & Smith, 2022). This is the second research gap I have aimed to address.

The third and final research gap relates to energy injustices in the context of Sweden. Relatively little has been published on justice issues pertaining to energy provision in Sweden (Ramasar et al., 2022). There may be historical reasons for this. Low electricity prices in combination with a strong welfare state have been perceived as a bulwark against social issues such as energy insecurity and energy poverty (von Platten, 2022b). According to Ramasar and colleagues (2022), the main body of research has focused on issues relating to the allocation of production sites and land grabbing (e.g. Bergek, 2010; Lawrence, 2014; Szpak, 2019), stakeholder participation and urban governance (e.g. Fenton et al., 2016; Gustafsson et al., 2015; Palm & Eriksson, 2018), and how historical injustices against the Sámi are being reproduced in contemporary energy policies (e.g. Cambou, 2020; Össbo & Lantto, 2011). However, their review concludes that very little research has focused on injustices related to the consumption of energy. Furthermore, the focus of previous research has almost exclusively been on disadvantaged actors. Hence, more research is needed on who benefits from the energy transition (Ramasar et al., 2022). In conclusion, there is a wide knowledge gap on energy injustices in Sweden, which is the third research gap that I have aimed to address.

1.4 Research objective and questions

The aim of this thesis is to add to our knowledge on user flexibility from an energy justice perspective. In so doing, it will shed light on the potential energy justice implications of user flexibility by looking at the ways in which it affects certain aspects of everyday life and explore how user flexibility is understood by various stakeholders.

In order to address this aim, I will explore the following research questions:

> **RQ1** How does the concept of flexibility capital inform the energy justice framework?
>
> **RQ2** What are the potential benefits and disadvantages of user flexibility from an energy justice perspective?
>
> **RQ3** How do various stakeholders (public news media, industry experts, and electric vehicle users) characterize and emphasize the key themes associated with user flexibility in the context of the energy transition?

RQ1 focuses on the theoretical links between the concept of flexibility capital and the energy justice framework. Thus, its contribution is primarily theoretical. The research question is explored by providing empirical evidence that legitimates the concept of flexibility capital. The evidence is then categorized according to the energy justice framework to demonstrate how the concept feeds into the framework.

The contributions of RQ2 and RQ3 are more empirical in nature. RQ2 focuses on both the perceived contributions of user flexibility to a just energy transition and the potential implications for energy justice. The question is explored through a conceptual review, a systematic literature review, and semi-structured interviews with respondents from both the supply and demand side. RQ3 focuses on exploring how various actors conceptualize user flexibility in order to understand the underlying ideas that drive its development and how user flexibility relates to the energy transition. This research question is addressed through a systematic literature review, semi-structured interviews, and surveys.

1.5 Scope and delimitations

In this thesis, I focus on the ways in which user flexibility may give rise to potential energy injustices. The focus is also on how various stakeholders understand and make sense of user flexibility within the energy transition. In doing so, I showcase the broader relevance of these questions for the transition to a low-carbon society.

Geographically, my research has focused on Sweden, which reflects the scope of CLUE, the research project within which I conducted my doctoral studies. More specifically, my research has been conducted in regions suffering from grid congestion and transmission constraints, namely the Stockholm region and the county of Skåne, with a particular focus on Malmö. The state of electricity transmission in these areas has led to several pilot programmes testing technologies and markets for user flexibility facilitation, which rendered these areas worthy of investigation. The geographical scope also included the region of Gothenburg. Although not yet affected by transmission constraints, the regional distribution system operator has decided to take a proactive stance as it is anticipated that grid congestion will affect the region in the future.

The research included different stakeholders and actors related to the transmission and consumption of electricity. On the supply side, my research included the transmission system operator, balancing system operators, state-owned multinational energy companies, privately owned multinational energy companies, municipally owned local energy companies, privately owned local energy companies, and flexibility aggregators. On the demand side, my research included households with electric vehicles. The reason behind this specific focus on users with electric vehicles was that the possibilities of controlled charging were being tested in Malmö at the time of the study, which presented an opportunity for investigating user flexibility and direct load control. The research also examined public news media to see how user flexibility was being discussed in public.

Energy can take many forms. In this thesis, I focus specifically on electricity and flexible uses of electricity. As mentioned in the introduction, user flexibility can be

enabled in several ways. The strategy for user flexibility facilitation that I focus on is direct load control, in which an external operator controls consumption, and the type of consumption on which I focus is electric vehicle charging. Controlled charging constitutes a very concrete strategy for decarbonizing the transportation sector with the help of user flexibility, while at the same time being an example of a change in electricity consumption that will have consequences for aspects of everyday life (Bailey & Axsen, 2015; Delmonte et al., 2020; Hardman et al., 2018; Will & Schuller, 2016).

Pertaining to my aim and research questions, there are also a number of limitations on the scope of the thesis. By focusing on direct load control, I have left out other types of flexibility enablers such as manual load control and automated load control. I have also been unable to address all the overlapping subfields within research on energy justice issues pertaining to the production and consumption of energy. For example, I do not explicitly address energy democracy. Nor do I specifically look into energy poverty, energy vulnerability, or fuel poverty.

1.6 Research process and overview of publications

On the 9th of January 2020, I was hired as a doctoral student within the CLUE research project. The aim of CLUE was to research the designing, planning, and operationalization of sustainable local energy systems. More specifically, this meant exploring more efficient means of producing, transmitting, and consuming electricity via smart technology, i.e., solutions that to a large extent focus on user flexibility. The goal of the CLUE project was to produce more knowledge about possible business models, develop recommendations for regulatory frameworks, and find viable forms of stakeholder involvement for facilitating user flexibility. The consortium of project partners from Austria, Germany, Scotland, and Sweden included actors from the public sector, the private sector, and academia (CLUE, n.d.). Across the four countries, the project had five demonstration sites for exploring different types of user flexibility. My role as a doctoral student was to follow and report on the development of the Swedish demonstration site in the city of Malmö.

Regardless of how well you plan your work, its execution will always be subject to unexpected events that alter the plans along the way. My thesis was no exception. As I was starting my employment, news was breaking about a new disease linked to a virus resistant to known vaccines and spreading rapidly across the world. I think it is fair to say that the Covid-19 pandemic left no one unaffected. Although I was fortunate enough not to fall seriously ill, and even though no one among my loved ones did either, I was still affected by the pandemic in the sense that the direction of my research was fundamentally changed. Social distancing restrictions made it

impossible to conduct the pilot studies as originally planned, and by the time the pilots had been modified to be feasible under the new conditions, my plan of research had changed.

When the pandemic rendered my initial research plans infeasible, my supervisor suggested that I should work on a paper that could be conducted as a desk study, such as a literature review. She also proposed that I should look into the ongoing debate in the media about grid congestion and transmission constraints, a topic that was hot news at the time and has only increased in relevance since. These prompts resulted in Paper II, which would eventually form the background to and define the scope of this thesis.

Here, I believe a couple of words about my previous academic training are also necessary to explain the turns that my research took. In 2016, I graduated from Lund University with a transdisciplinary Master's Degree in Environmental Studies and Sustainability Science (LUMES). LUMES is a programme that integrates both social and natural science perspectives to foster an understanding of how the interactions of social, economic, and environmental systems shape the world. Special emphasis is placed on normative and value-based issues, human well-being, and social equity. Needless to say, the training at LUMES has influenced my research and my understanding of the world. Thus, when commencing the research for Paper II, I was struck by the unequal nature of the public discourse. Certain voices were given more space than others, certain ideas were given priority, and old thinking appeared to be perceived as the truth. Reading about how the establishment of large data centres was affecting the lives of local communities, I realized that unequal power relations were currently being built into the system. (This realization led to a side-track and resulted in a paper where I liken the development of the energy sector to gentrification (Libertson et al., 2021). The paper is not included in the thesis, but I can highly recommend it.) It did not take long before the initial ideas of investigating business models and the economic viability of user flexibility were gone. Instead, I focused on exploring the potential energy injustices to which user flexibility might give rise.

As for the remainder of my papers (Table 1), I believe that a few words about their relation are warranted. Paper I conceptualizes user flexibility as a form of capital. It offers a conceptual review and integrates the concept of flexibility capital with the concept of socio-temporal configuration. It establishes a theoretical understanding of user flexibility and of how providing user flexibility is a complicated action that must reconcile the social, temporal, material, technological, and economic factors of everyday life. This concept forms the theoretical foundation of the thesis. Paper II is a systematic review of the literature on ten years of public discourse in Swedish media related to the state of transmission lines. By exploring how different energy narratives are presented in public discourse, Paper II demonstrates how notions of user flexibility have been disseminated over the last ten years. In doing so, Paper II establishes a link to Papers III and IV, as the ideas of the narratives are reflected in

the opinions of the respondents. More concretely, the paper shows how user flexibility is associated with progressive ideas on renewable energy and sustainability, which are mirrored in the consciousness of industry experts and end users. Paper III constitutes a qualitative study that explores industry experts' perception of user flexibility and the potential energy injustices it might give rise to. Thus, it examines the norms and values of industry experts that drive the development of user flexibility. Paper IV comprises a mixed-methods case study that investigates the attitudes of end users to user flexibility. It also explores how the respondents foresee user flexibility impacting their daily lives.

Table 1
Overview of publications.

#	Publication	Methods for data collection	Methods for data analysis	Relevance
1	(No) room for time-shifting energy use: Reviewing and reconceptualizing flexibility capital	Conceptual review Narrative literature review	Flexibility capital Socio-temporal configuration	Theory
2	Competing socio-technical narratives in times of grid capacity challenges: The representative case of Sweden	Systematic literature review	Discourse analysis Socio-technical narratives	Background/results
3	Misalignments of theory and practice: Exploring Swedish energy utilities' understandings of energy justice, flexibility capital and a just energy transition	Semi-structured interviews (24)	Energy justice Flexibility capital	Results
4	Requesting control and flexibility: Exploring Swedish user perspectives of electric vehicle smart charging	Semi-structured interviews (27) Surveys (1428 + 55)	Framework of knowledge and perceptions Flexibility capital	Results

Paper I

(No) room for time-shifting energy use: Reviewing and reconceptualizing flexibility capital

Paper I explores the factors that mediate the capacity for user flexibility by building on the idea of flexibility capital, a theoretical concept that conceptualizes the ability to be flexible as a form of capital. In line with Bourdieu's idea of different forms of capital (Bourdieu, 1986), the capacity to be flexible and the ability to monetize one's flexibility are seen as the outcome of economic assets, social relations, and knowledge. Paper I expands on these ideas by integrating the concept of flexibility capital with the concept of socio-temporal configuration to better understand how

societal and temporal factors influence the capacity to be flexible. By conceptualizing and integrating these factors with the existing concept, the paper establishes a theoretical understanding of how providing user flexibility is a complicated action that must reconcile the social, temporal, material, technological, and economic factors of everyday life. The paper then applies the new conceptualization to previous studies of the user experience of technologies to facilitate user flexibility. In doing so, Paper I contributes to answering RQ1 and RQ2 by 1) demonstrating how different users have different needs and capacities in relation to user flexibility and 2) showing how the uneven distribution of flexibility potential in society may amplify energy injustices related to user flexibility.

Paper II

Competing socio-technical narratives in times of grid capacity challenges: The representative case of Sweden

Paper II explores the changing landscape of the energy sector by investigating how challenges and opportunities have been imagined and discussed in the media. By applying the theoretical framework of socio-technical narratives, the paper analyses the media discourse surrounding grid congestion in Sweden over a ten-year period. In doing so, it contributes to answering RQ2 and RQ3. Two competing narratives were found, referred to as the centralized narrative and the decentralized narrative. Each narrative conveys its own interpretation of the cause of grid congestion and how it is best resolved. The centralized narrative adopts a reformist approach to solving the predicament within the current structures of the energy system, while the decentralized narrative challenges this notion and seeks to solve the grid congestion by transforming the system into a decentralized structure. Neither approach is probably sufficient on its own; however, the dominance of the centralized narrative in the media risks overlooking the many potential solutions that the decentralized narrative offers, such as a more flexible system.

Paper III

Misalignments of theory and practice: Exploring Swedish energy utilities' understandings of energy justice, flexibility capital and just energy transition.

It is imperative that the energy transition avoids transferring old injustices to the new energy system. This conviction references energy justice, a framework that seeks to assess and promote the equal distribution of energy burdens and benefits. Paper III explores the extent to which this framework is known among energy utilities and whether it informs their operations. The paper also investigates how energy utilities and industry experts understand user flexibility. It thus contributes to answering RQ2 and RQ3. The results identify four general perspectives on energy justice and user flexibility, each with a unique emphasis on technology, humans, and the environment. The paper concludes that there is a misalignment between the

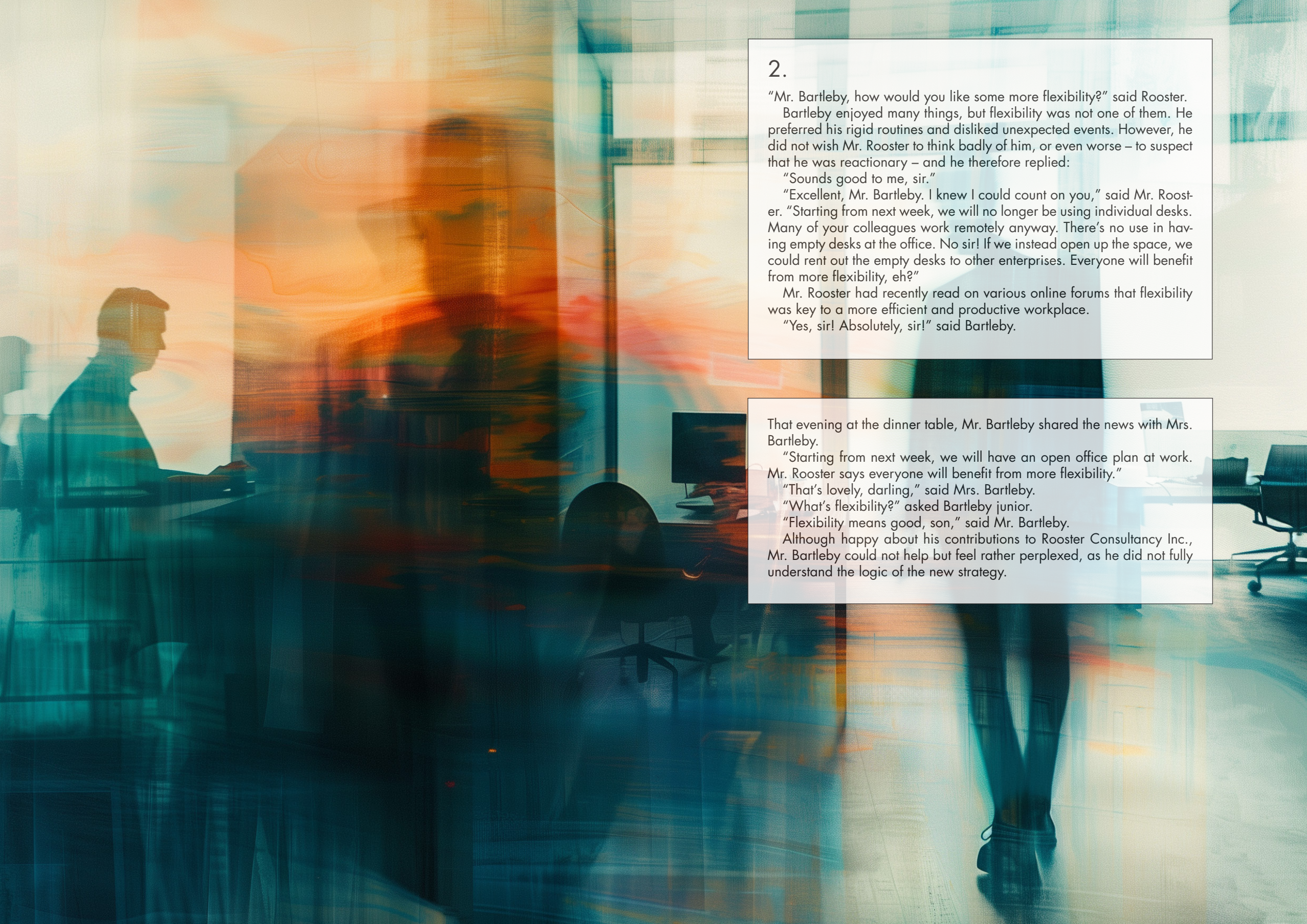
theoretical and practical understandings of user flexibility and its associated potential energy injustices, and argues that both academia and the energy sector would benefit from more collaboration in order to avoid future energy injustices.

Paper IV
Requesting control and flexibility: Exploring Swedish user perspectives of electric vehicle smart charging

In order to avoid energy peaks and to use the existing infrastructure more efficiently, end users are encouraged to allocate their electricity use to timeslots when demand is low. They can do this by using smart appliances to adapt their electricity use and so promote more stable consumption. For example, they can use smart charging technologies when charging electric vehicles. However, engaging in smart charging entails relinquishing some control over the charging process while also being more flexible. Paper IV examines how end users respond to this new approach to electricity consumption and the effects they foresee on their everyday lives. It thus contributes to answering RQ2 and RQ3. The findings show that although end users view the concept of smart charging positively, they also associate flexible electricity use with uncertainty and anxiety. The respondents deemed their capacity to be flexible to be partly outside their control, as the study found that factors beyond user acceptance influence end user capabilities.

1.7 Thesis outline

The thesis proceeds as follows: in Chapter 2, I explain why I believe that the energy transition should be just. I do so by outlining the reasons why justice and equity are necessary for the energy transition and by introducing the normative position that I take throughout the thesis – energy justice. In Chapter 3, I introduce the concept of flexibility capital (Paper I) – the theoretical framework that forms the conceptual foundation of this thesis. The concept builds on Bourdieu's (1986) understanding of capital as the resources that determine the opportunities of individuals and the extent to which they wield power in society. Chapter 4 presents the overall research processes of the thesis. Chapter 5 delves into the findings from my research in order to provide insight into how the public news media (Paper II), the energy sector (Paper III), and users (Paper IV) perceive user flexibility. In Chapter 6, I discuss my results by presenting them as two stories of user flexibility: one depicts user flexibility as a way to successfully decarbonize society and increase energy justice while the other regards user flexibility as likely to decrease energy justice. I conclude the chapter by discussing ways to minimize the potential energy injustices of user flexibility. In the final chapter, Chapter 7, I return to the core inquiry of the thesis to answer my research questions.



2.

"Mr. Bartleby, how would you like some more flexibility?" said Rooster.

Bartleby enjoyed many things, but flexibility was not one of them. He preferred his rigid routines and disliked unexpected events. However, he did not wish Mr. Rooster to think badly of him, or even worse – to suspect that he was reactionary – and he therefore replied:

"Sounds good to me, sir."

"Excellent, Mr. Bartleby. I knew I could count on you," said Mr. Rooster. "Starting from next week, we will no longer be using individual desks. Many of your colleagues work remotely anyway. There's no use in having empty desks at the office. No sir! If we instead open up the space, we could rent out the empty desks to other enterprises. Everyone will benefit from more flexibility, eh?"

Mr. Rooster had recently read on various online forums that flexibility was key to a more efficient and productive workplace.

"Yes, sir! Absolutely, sir!" said Bartleby.

That evening at the dinner table, Mr. Bartleby shared the news with Mrs. Bartleby.

"Starting from next week, we will have an open office plan at work. Mr. Rooster says everyone will benefit from more flexibility."

"That's lovely, darling," said Mrs. Bartleby.

"What's flexibility?" asked Bartleby junior.

"Flexibility means good, son," said Mr. Bartleby.

Although happy about his contributions to Rooster Consultancy Inc., Mr. Bartleby could not help but feel rather perplexed, as he did not fully understand the logic of the new strategy.

2 The case for a just energy transition

For the past decade, social scientists in energy research have increasingly been highlighting social injustices on both local and global scales in relation to the production and consumption of energy. These injustices, they argue, constitute reasons for emphasizing ethical considerations in energy policies to a greater extent than has been done up till now. The uneven distribution of energy benefits and energy burdens requires a more holistic approach to energy policies; an approach that goes beyond merely technical and economic considerations (Heffron et al., 2015; Jenkins, McCauley, & Forman, 2017). Ergo, energy justice – a systematic framework for normative evaluation of the environmental and social implications of energy policies. However, advocating for justice in energy policies implies taking a moral standpoint and an attempt to invoke an ethical rule or principle of governance, namely that fairness in energy policies is something good and desirable while injustice and inequality are bad and should be avoided. In essence, calling for justice resembles a declaration of universal 'rights' or 'wrongs' and an assertion of a universal truth that energy policies should abide by. To date, energy justice research has been very successful in identifying the rights and wrongs of contemporary energy policies based on principles of universal justice. However, less attention has been given to the moral grounds on which the principles of energy justice rest and why justice matters for the energy transition (Galvin, 2020).

In this chapter, I will make a very modest attempt to explain why I believe the energy transition should be just. I do so by outlining the reasons justice and equity are necessary for the energy transition (section 2.1) and by introducing the normative position I take throughout the thesis – energy justice (section 2.2). As this thesis seeks to explore the potential energy justice implications of user flexibility, it is important to establish the moral grounds of the justice claims, as well as define what is meant by justice.

2.1 Just energy transitions

> It has become fashionable to insist on an impending energy crisis. The euphemistic term conceals a contradiction and consecrates an illusion. It masks the contradiction implicit in the joint pursuit of equity and industrial growth (Illich, 1979, p. 1).

Long before energy justice became an established term (Jenkins, McCauley, et al., 2016; Sovacool & Dworkin, 2015), Ivan Illich (1926-2002) highlighted the discrepancy between indefinite expansion of energy use and social issues. Illich (1979) argued that insisting on an energy crisis, rather than acknowledging the intrinsic flaws of the energy system, would mask the contradiction between industrial growth and the pursuit of equality. He foresaw that the increasing use of energy and the indefinite expansion of the energy system would erode social relations and eventually destroy the physical environment. Instead of bringing more equity, perpetual growth would lead only to a negative form of decoupling in which further energy output would contribute to little, no, or even negative human development (Illich, 1979). Yet the ideas of economic growth (Hickel & Kallis, 2020) and industrial expansion continue to dominate contemporary energy policies (Ingeborgrud et al., 2020).

Illich (1979) was writing against the backdrop of the oil crisis in the 1970s; however, his sentiment might as well have been contemporary. Scrutiny of the present-day energy sector reveals the unresolved effects of the energy dilemma that Illich spoke of. The prevailing dependence on fossil fuels, increasing energy prices, unstable energy production, wavering grid stability, and growing demand are causing a questionable redistribution of wealth from consumers to producers (IEA, 2022). Illich's thinking challenges the ideologies and assumptions that underpin the energy transition and illuminates the equity implications of the expansion of the electricity system that current decarbonization strategies necessitate. Thus, assuming that energy justice is something desirable, it is only reasonable to reflect on the underlying ideological assumptions that currently are driving the energy transition.

In the remainder of this section, I outline four reasons why the energy transition requires a focus on equity and justice: 1) the inherent inequalities of climate change, 2) the equity implications of contemporary decarbonization strategies, 3) the opportunity to remedy old wrongs, and 4) the importance of public approval. Although most of the arguments are at a global level, they constitute general arguments that are valid regardless of the level.

The first, and perhaps most significant, argument for why justice matters for the energy transition is the asymmetrical power relations between the Global North and the Global South that underpin climate change. The pending ecological crisis is caused by human activities, such as changes in land use and fresh water use, energy expenditures, and greenhouse gas emissions (Crutzen, 2016; Steffen et al., 2011). Climate change is commonly portrayed as an anthropogenic problem caused by humanity, and as a challenge that humanity must solve together. Although the latter is likely true, the fact is that climate change is largely caused by a minority of the world's population (Lövbrand et al., 2015; Malm & Hornborg, 2014; Swyngedouw, 2010), The Global North, which has historically been the largest emitter of greenhouse gas emissions, will likely suffer the least from climate change. Instead, it is the Global South, which has emitted the least, that will suffer the most (Steffen

et al., 2011). Furthermore, the advantage in material wealth that the Global North has over the Global South was made possible by the former's exploitation of the latter. The notion that the Global South will eventually 'catch up' with the development of the Global North is a fallacy, for the North's advantage is based on and perpetuated by an asymmetrical distribution of power relations and material wealth (Malm & Hornborg, 2014). Thus, framing climate change as anthropogenic, rather than as flowing from the behaviour of wealthy nations, hides the inherent global inequalities of climate change (Lövbrand et al., 2015). True remedies for climate change, such as the energy transition, require addressing the root causes of global warming by looking at the inequalities that led to it. The focus of this thesis is user flexibility, which to a large extent is a local solution to the global problem of climate change. However, the inequalities of the global problem compel every solution to incorporate justice perspectives, regardless of the level. Anything else will produce only limited results.

This leads to the second argument for a just energy transition, namely the equity implications of current strategies for sustainable development. The lack of progress toward a sustainable transition calls for scrutiny of the underlying ideological assumptions of current policies (O'Brien, 2013). To assume that contemporary imaginations of a sustainable future exist in a vacuum or are free from biases or influences from political and economic ideologies is a fallacy (Luederitz et al., 2017). Take the example of green growth – the notion that sustained economic growth will bring about social and environmental sustainability. Green growth advocates for more governance and relies on market mechanisms and technological innovation to address sustainability issues. It thus takes current political and economic paradigms for granted, and in doing so it advocates for more of the same. In essence, green growth is the idea that the problems of economic growth can be solved with more economic growth (Birch, 2017; Hickel & Kallis, 2020). However, there is no empirical evidence that economic output can be decoupled from its social and environmental impacts. Even under very optimistic conditions, models indicate that absolute decoupling is not feasible in the long term (Parrique et al., 2019). On the contrary, it is reasonable to assume that more economic growth will lead to more economic inequality (Piketty, 2020) and environmental destruction (Swyngedouw, 2010). In addition, there is an imminent risk that contemporary strategies for decarbonization will disproportionately affect the most vulnerable groups in society (Wood & Roelich, 2019). This point calls attention to the opening quote by Illich (1979); that there is an inherent and inevitable trade-off between growth and equity. More explicitly, the increased uses of electricity that the energy transition advocates will come at the cost of social equity. Following this logic, the only means of addressing inequalities is to stop subordinating basic human needs and human welfare to growth imperatives (Heffron et al., 2015; Neuteleers et al., 2017) and to question the ideological assumptions of current sustainability strategies for decarbonizing society (Lövbrand et al., 2015; O'Brien, 2013) by placing social equity and justice at the centre of attention. This argument is particularly relevant

for user flexibility policies, as user flexibility is commonly imagined as a form of new market (D'hulst et al., 2015; Smale et al., 2017).

The third argument for a just energy transition relates to the opportunity to remedy old wrongs. Historically, the problem of climate change has been formulated in terms of preventing global greenhouse gas emissions, rather than in terms of the unequal power relations that have enabled further pollution (Swyngedouw, 2010). However, changing this energy regime provides an opportunity to address the social injustices that the unequal power relations have caused (Healy & Barry, 2017; Newell & Mulvaney, 2013). The energy transition constitutes an opportunity to critically examine old energy injustices, that is, to investigate the distribution of energy benefits and energy burdens throughout society, identify the beneficiaries and the disadvantaged, and examine the policies that have allowed energy injustices to continue (Baker et al., 2019).

The fourth and final argument for a just energy transition relates to public acceptance of sustainability policies. In general, policies tend to meet with higher levels of endorsement if they are perceived as fair and just. Conversely, policies that are seen as unfair or as benefitting only some actors will likely be disapproved of and will meet with resistance until they are rectified (Huijts et al., 2012). Contemporary global energy systems constitute a political economy that tends to prioritize the interests of wealthy elites over those of environmentally vulnerable groups (Newell & Mulvaney, 2013). Thus, in order to gain more public support for policies that seek to facilitate the transition to a low-carbon society, policymakers should render the policies as inclusive as possible. Basic human needs and human welfare should supersede profit-making, and the energy transition should not only include those who can afford it (Neuteleers et al., 2017). Successful implementation of user flexibility relies on public support, which underscores the need for policies that promote acceptance, inclusion, and fairness.

The four arguments for a just energy transition presented above (i.e., the inherent inequalities of climate change, the equity implications of contemporary decarbonization strategies, the opportunity of remedying old wrongs, and the importance of public approval), all fall within the Kantian branch of philosophy as they seek to find universal moral imperatives for justice through logic and reasoning. This philosophical tradition is called the 'rational metaphysical' approach; however, there are several other philosophical traditions that aspire to define moral claims. Galvin (2020) for example, draws on the work of Ludwig Wittgenstein in his attempt to explain the moral grounds for a just energy transition. This tradition of philosophical thinking sees moral commitments as integral to a meaningful life:

> Moral commitments and beliefs go toward giving meaning to one's life and are thereby a central part of being human. A person without a moral compass is a disintegrated being, a being who cannot participate effectively in the practices of their

> community. This has countless everyday forms, many of which are so mundane as to hardly be noticed, such as how we take turns in everyday conversation, how we buy and sell things, how we listen when someone tells us their fears and hopes, how we know when to physically touch another person. It also has very strong social-critical dimensions, such as how we learn our government is acting worthily or not (Galvin, 2020, p. 83).

In other words, justice matters for the energy transition because if we as a society stop caring about our fellow human beings, this will affect not only other aspects of society but also the quality of our own lives. A life without moral commitments such as the aspiration for justice is a life without meaning, and a life without meaning is a half-life. My goal is not to delve into the many traditions of moral philosophy, let alone try to explain them. The point I am making is that there are numerous ways in which the case for a just energy transition can be made. For now, it suffices that I have outlined four rational arguments for why justice matters for the energy transition (even though the list is by no means complete) and have shown that there are philosophical moral arguments for the significance of justice for society. In the following section, I introduce the framework of energy justice, which is the normative position of this thesis and an idea for realizing a just energy transition.

2.2 Energy justice

The response to energy injustices should be to advocate for a just energy transition (Healy & Barry, 2017). This is the domain of energy justice; a social movement and research field within the social sciences that seeks to highlight the justice implications and long-term effects of energy systems (Baker et al., 2019; Jenkins, McCauley, et al., 2016; Sovacool & Dworkin, 2015). As a social movement, energy justice strives for equity in both the social and economic domains of energy systems, while also seeking to remedy historical ills to those harmed by systems of energy provision. Energy justice specifically emphasizes the concerns of marginalized actors and works towards making energy more accessible, affordable, and democratic for all actors (Baker et al., 2019). As a research field, energy justice constitutes a form of evaluative and normative analysis of the long-term effects of changes to the energy sector (Heffron & McCauley, 2017; Sovacool et al., 2017).

Energy justice builds on the traditions of environmental justice and climate justice. Environmental justice gained momentum in the US in the 1980s as both a civil rights struggle and a scholarly field when it became evident that communities of colour were being disproportionately affected by environmental harms such as hazardous garbage dumping, exposure to pesticides, and arbitrary environmental laws (Baker et al., 2019; Svarstad & Benjaminsen, 2020). Climate justice arose in the early 2000s as a response to the recognition that climate change would affect people of the

Global South the hardest, despite their minimal contribution to it (Jenkins, 2018). Both environmental justice and climate justice uphold a set of principles that advocate for procedural and distributional justice. The heritage of these traditions highlights how environmental issues and sustainability are inextricably linked to social equity (Baker et al., 2019).

Energy justice rests on the assumption that human-made systems, such as electricity systems, are inextricably intertwined with the governance modes of society, with the result that the social hierarchies of society are inevitably built into these systems (Burke & Stephens, 2018; Healy & Barry, 2017; Newell & Mulvaney, 2013). This implies that equity issues and social injustices are also replicated in energy systems (Sadowski & Levenda, 2020). To prevent the introduction of new injustices or the reinforcement of old inequities when transitioning to a low-carbon society, energy justice argues that ensuring justice should be at the centre of the development of new energy systems (Jenkins, McCauley, & Forman, 2017). Thus, energy justice seeks to identify and propose solutions to energy inequalities by urging policymakers to diversify energy policies to include a variety of disciplines rather than basing their policies on narrow neo-classical economics thinking (Heffron & McCauley, 2017; Jenkins, McCauley, et al., 2016; Sovacool & Dworkin, 2015).

Energy justice is an integral part of a just energy transition in that it raises questions about the fairness and equity of the current energy system and promotes democracy, cooperation, and regeneration in the transition to a new and more sustainable system (Baker et al., 2019). Energy justice offers a form of both evaluative and normative analysis that rests on the three principles of distributional justice, recognition justice, and procedural justice (Heffron et al., 2015; McCauley et al., 2013). Together, the principles a) analyse the distribution of energy benefits and energy burdens that give rise to energy injustices, b) identify who might be disadvantaged by an asymmetric distribution, and c) propose fair processes for just solutions (Jenkins, McCauley, et al., 2016). Distributional justice enquires into the geographic, demographic, and temporal distributions of the costs, risks, and rewards associated with energy systems. To determine the distribution of burdens and benefits, it considers factors such as the siting of power production facilities and the availability of their outputs (Heffron et al., 2015; Jenkins, McCauley, et al., 2016; McCauley et al., 2013). Once the potentially asymmetrical distributions have been identified, recognition justice examines the interests, needs, and values of different stakeholder groups in order to determine whether certain groups are being misrecognized in relation to their share of risks and costs. (Jenkins, McCauley, & Warren, 2017). Misrecognition can occur due to cultural domination, non-recognition, or disrespect, and it is commonly connected to factors such as class, gender, race, and ethnicity (Svarstad & Benjaminsen, 2020). Recognition justice also identifies and examines those who are benefitting from maldistribution (Ramasar et al., 2022). Lastly, procedural justice proposes procedures for resolving maldistributions and misrecognitions. It evaluates the decision-making processes that govern energy systems in terms of their

transparency, accountability, inclusion, and representation (Heffron et al., 2015; Jenkins, McCauley, et al., 2016; McCauley et al., 2013).

By adopting the normative perspective of energy justice, I position my research in a tradition that advocates for justice in the energy transition, based on the moral grounds of fair distribution and procedures that minimize harm. Thus, questions of capacities, agency, and fairness of procedures in relation to user flexibility schemes are of particular interest in the thesis. Chapter 6 will outline the potential justice implications of user flexibility by looking at aspects of distribution, recognition, and procedure.

3.

The following week, Bartleby had trouble settling in at his new desk. To start with, it was not his desk anymore. Gone were all the personal items. In front of him lay instead a clean desk, harbouring only two blank computer screens and a keyboard. It took him several moments before he could remember what it was that he was supposed to do.

Bartleby found the situation quite confusing. The office appeared to be in turmoil, and yet, his colleagues were as jolly as ever in their attempts to navigate the new working strategy. In addition to his regular colleagues, there were also several new faces that Bartleby did not recognize.

"Good morning, Mr. Bartleby! Lovely morning, eh?"

Mr. Speed, the colleague who used to sit next to Bartleby, stopped by his desk. The regular morning routines and preparations for the workday occupied a considerable amount of time this morning.

"He ought to be called Mr. Slow," Bartleby reflected, as Mr. Speed gave a detailed account of his catch from the weekend's fishing trip.

"It is just a transition phase," assured a manager loudly when a few colleagues had trouble finding empty desks.

Inspired by the new look and energy of his business, Mr Rooster set out to increase efficiency and productivity even further. A month later he announced to Bartleby:

"Mr. Bartleby, I am going to make you a freelancer! Starting next week, I will instead be hiring you as a contractor. The freedom of freelancing is an efficiency booster! Mark my words, Mr. Bartleby, your productivity will go through the roof!"

"Yes, sir! Absolutely, sir! said Bartleby.

"Imagine that, Mr. Bartleby! You're going to be a CEO!"

Bartleby very badly wanted to enjoy the prospects of having his own firm, but no matter how hard he tried he was unable to understand why he could not remain a regular employee.

3 Energy justice and user flexibility

In this chapter, I introduce the concept of flexibility capital – the theoretical framework that forms the conceptual foundation of this thesis. The concept builds on Bourdieu's (1986) understanding of capital as the resources that determine the opportunities of individuals and the extent to which they wield power in society (Bourdieu, 2006). Bourdieu's work offers a comprehensive framework for understanding societal structures and for scrutinizing power relations and imbalances. As such, it provides an explanation for the occurrence of injustices. By focusing on the individual and their capacities, Bourdieu (1986) highlights the relationship between the micro and the macro level of society and shows how the resources and capacities of individuals translate into structural injustices (Husu, 2022).

Applying the concept of flexibility capital as a theoretical framework means that I subscribe to Bourdieu's (1986) understanding of the relationship between societal structures and individual capacities. From this perspective, systemic energy injustices are understood as the result of the individual conditions of the users. It is the individual capacities and resources of the users that explain why different users have different opportunities to engage with energy systems. Application of the flexibility capital concept thus implies an inquiry into the factors that determine the individual capacities of users in order to extrapolate how these differences may or may not materialize as energy injustices on a societal level.

3.1 Flexibility capital

In his exploration of the correlation between resources and social power structures, and how the synergy between the two maintains and reproduces social systems of hierarchy, Bourdieu (1986) expands the notion of capital beyond purely economic terms. He distinguishes between several forms of symbolic capital to indicate how different societal groups enjoy different levels of capacities and influence in society. In addition to having a certain stock of economic capital (such as monetary and material resources), individuals and groups also possess cultural capital (information, knowledge, and skills), social capital (social relations and personal networks) and symbolic capital (social status and reputation). Together these capitals constitute a portfolio that either restricts or enables individuals and groups

in their daily lives. Scrutiny of capital portfolios highlights the correlation between positions in society and these portfolios, and shows how individuals and groups in society exert their power by mobilizing their capital in a continuous conversion of one form of capital into another (Husu, 2022). Thus, a person with much cultural capital will have more opportunities to advance their social position and create economic revenue streams than a person with little cultural capital. Furthermore, the scrutiny of capital portfolios highlights how the uneven distribution of resources and capacities in society leads to unequal opportunities and injustices.

Powells and Fell (2019) and I (see Paper I) build on these theories in the conceptualization of flexibility capital. In essence, flexibility capital is the capacity to be flexible in one's use of energy. Furthermore, in accordance with Bourdieu's (1986) theories, flexibility capital also indicates the energy user's ability to economize their flexibility. Several factors influence the amount of flexibility capital a user has in their possession, and these factors relate to material and immaterial resources and assets as well as to the socio-temporal configuration of the user. Examining these factors and their uneven distribution across society reveals that flexibility is a matter of socio-economic status and social class, and thus a potential source of energy inequity. Table 2 summarizes the factors influencing a user's flexibility capital. These factors will be elaborated on in sections 3.2 and 3.3.

Table 2
List of factors influencing the flexibility capital of a user (adapted from Papers I and III)

Form of capital	Sets of factors	Factors influencing flexibility capital
Flexibility capital	Resources and assets	Financial assets
		Material assets
		Technological resources
		Knowledge
		User size
	Socio-temporal	Geographical patterns
		Norms
		Conventions
		Space
		Public infrastructure
		Others
		Bodily needs
		Novelty

At the core of the flexibility capital concept is the understanding that users can monetize their flexibility, that is, that under certain conditions they can convert their flexibility into economic capital (Powells & Fell, 2019). This understanding also implies an inherent injustice. Since flexibility capital is determined by several

factors (wealth, knowledge, technology, lifestyle, and so forth) different users will have different opportunities to realize the economic potential of their flexibility (Calver & Simcock, 2021; Fjellså, Ryghaug, et al., 2021; Fjellså, Silvast, et al., 2021; Powells & Fell, 2019). Inherent injustice also lies in the fact that the factors that determine flexibility are to some extent beyond the control of the user, due to their complexity and their embeddedness in daily life (Libertson, 2022b; Nyborg, 2015).

Worthy of note is also how the flexibility capital concept understands the action of providing flexibility. Rather than being a commodity that is sold in a single transaction, providing flexibility should be regarded as a continuous service (Powells & Bulkeley, 2013). In essence, being flexible is an ongoing effort. This understanding of flexibility is in stark contrast to that of industry and market actors who consider flexibility as a resource rather than a capacity (Adams et al., 2021).

3.2 Resources and assets

The first set of factors influencing flexibility capital are the material and immaterial resources and assets that the user has in their possession, or as Powells and Fell (2019) refer to it, their 'affluence'. In what has been suggested to be the most notable positive correlation, flexibility capital and ***financial assets*** are deemed to go hand-in-hand. Greater financial assets mean that the capital costs of investing in smart technologies for providing flexibility are more affordable. For example, more affluent users can afford to pay up-front for appliances such as solar panels, battery storage, and smart meters, thereby increasing their technology-derived flexibility (Calver & Simcock, 2021).

Material assets, most notably the home of the user, may also influence user flexibility. For example, homeowners in general have more opportunities to install smart technologies than tenants, which increases their flexibility capital (Powells & Fell, 2019). Conversely, living in rental apartments in general and in shared accommodations in particular has been observed to entail less flexibility capital (Fjellså, Ryghaug, et al., 2021). Not only does renting mean less freedom as regards potential changes to the home, but co-living also implies compromising and synchronizing activities to a larger extent, which fixes and 'locks' activities in time, thus also reducing flexibility.

Smart technologies and appliances are at the core of the facilitation of flexibility. Thus, the extent to which the user has access to ***technological assets*** will inevitably influence their flexibility capital. For example, within the transport sector, smart charging of electric vehicles is a means of optimizing the charging and providing user flexibility, but the willingness of users to provide flexibility in smart charging schemes has been observed to be dependent on their access to charging stations.

Users with a private charging station were more willing to provide flexibility than users relying on public infrastructure. The type of vehicle driven was also noted to influence user flexibility capital (Libertson, 2022b).

Having ***knowledge***, both of the technology and of how to economize to accommodate flexibility, may impact flexibility capital. For example, having know-how about flexible uses of electricity was observed to spark interest in maximizing user flexibility. Conversely, lacking capabilities appeared to result in disinterest in becoming involved in flexibility schemes or in understanding fundamental concepts of providing flexibility (Fjellså, Silvast, et al., 2021).

Lastly, the ***size of the user*** is also likely to influence their flexibility capital (Cardoso et al., 2020; Conway, 2015). Smaller users are likely to be more agile and thus quicker to respond to price signals and changing conditions; however, larger users will likely have larger arsenals of resources that they can deploy (Libertson, 2024).

3.3 Socio-temporal factors

As seen in the previous section, material and immaterial assets and resources constitute one set of factors for providing flexibility. A second set of factors that influence flexibility capital relate to the social and temporal dimensions of society (Libertson, 2022a). This understanding of flexibility is based on the idea that temporal dimensions organize and structure human actions and their associated energy use in complex chains of activities. It is the temporal dimensions that determine the point in time when an activity takes place and the interconnections of supporting or competing activities (Blue et al., 2020; Cass & Shove, 2018; Southerton, 2006). From this point of view, flexibility is not primarily a matter of individual choice but rather a matter of how social and temporal factors configure the lives of the users. The temporal dimensions that create these societal social rhythms are tempo, duration, sequencing, synchronicity, and periodicity (Fine, 1996).

Tempo refers to the pacing of an activity, whereas duration describes its length (e.g., minutes, hours, days) (Adam, 2000; Fine, 1996; Southerton, 2006). Sequence pertains to the order in which activities must take place. For example, certain activities require supporting activities that either precede or succeed them, creating locked chains of events. A common example is laundry, which cannot be dried before it has been washed (Blue et al., 2020; Cass & Shove, 2018). Synchronicity describes whether the activity is dependent on other parallel activities, and whether it requires the cooperation and presence of other people (Blue et al., 2020; Southerton, 2006; Walker, 2014). Lastly, periodicity pertains to the intervals at which the activity occurs, whether daily, weekly, or monthly (Blue et al., 2020; Fine, 1996; Walker, 2014). It is the configuration of these intricate connections that

ultimately decides the extent to which activities are flexible (Blue, 2018). User flexibility, then, becomes a matter of whether chains of activities can be fragmented, that is, whether the activities and their electricity use can be interrupted, detached in time, and decoupled from one another (Cass & Shove, 2018), as seen in Figure 1.

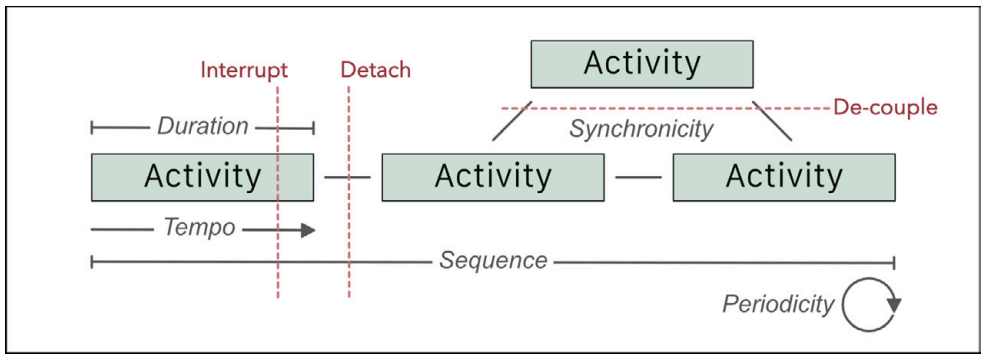


Figure 1
Generalized illustration of the five temporal dimensions of activities and how user flexibility implies fragmenting the daily chains of activities.

The temporal dimensions manifest themselves in daily life in several ways, and it is these manifestations, or socio-temporal factors, that influence the flexibility capital of the user. The socio-temporal factors exist and influence users on multiple levels of society, and consist of geographical patterns, conventions, norms, space, public infrastructure, others (as in fellow human beings), bodily needs, and novelty. ***Geographical patterns and seasonality*** such as daylight, weather, and seasons influence flexibility capital, in that they create needs for warming, cooling, and artificial light which cannot always be overlooked (Jalas & Numminen, 2022; Shove, 2009; Walker, 2014). For example, Strengers (2010) highlights how air-conditioning practices in warm climates may constitute limiting factors for providing flexibility. ***Conventions***, such as work, school, commerce, laws, and religion influence flexibility in that they create institutional arrangements that dictate when certain activities occur, such as commuting, work hours, and leisure (Friis & Christensen, 2016; Powells et al., 2014; Zerubavel, 1985). Ozaki (2018) notes that daytime hours are normally spent on commuting and working, which means that household chores must generally be allocated to evenings. Attempts to rearrange these timeslots to provide flexibility have been observed to result in stress for users (Friis & Christensen, 2016; Hargreaves et al., 2010). ***Norms*** prescribe or proscribe acceptable and unacceptable behaviours in society (Lapinski & Rimal, 2005), which can dictate the timing of certain activities (Adam, 2000; Blue et al., 2020; Nicholls & Strengers, 2015). For example, households have been observed to avoid doing their laundry at night so as not to disturb their neighbours (Higginson et al., 2014) and family members (Nyborg & Røpke, 2013). ***Space*** may put physical

limitations to the timing of certain activities, and thus also influence flexibility (Cass & Shove, 2018; Sovacool et al., 2020). For example, living in confined spaces was observed to restrict when certain household chores could be done (Friis & Christensen, 2016). Space, and specifically the geographical location of the user, has also been observed to influence the frequency with which the user will be asked to adapt their electricity use (Sæle et al., 2023; Savelli & Morstyn, 2023). The ***public infrastructure*** that enables commuting, communication, broadcasting and other societal functions also structures life, for their availability and distribution can facilitate or impede the timing and occurrence of activities (Blue et al., 2020; Jalas & Numminen, 2022; Ramirez-Mendiola et al., 2022). For example, time-shifting the charging of electric vehicles has been observed to influence daily life (Friis & Christensen, 2016; Nyborg, 2015). The organization of labour and housing may also influence flexibility in that it may require collaboration and dependence on ***others*** (Nicholls & Strengers, 2015; Powells et al., 2014; Southerton, 2006). Providing flexibility under these circumstances may come with both benefits and challenges, since while the workload can be divided (Higginson et al., 2014; C. Johnson, 2020) the activities must also be coordinated and synchronized (Nyborg, 2015; Skjølsvold et al., 2017). Lastly, ***bodily needs***, such as the need for food, sleep, hygiene, warmth and cooling, will influence related activities and related electricity use (Higginson et al., 2014; Hoolohan et al., 2018; Strengers, 2010). Bodily needs have been observed to fix certain electricity uses in time, such as mealtimes (Christensen et al., 2020; Öhrlund et al., 2019; Tjørring et al., 2018) and indoor temperatures (Nyborg & Røpke, 2013; Outcault et al., 2018) in time. Finally, when it comes to the flexibility of industries and businesses, it has been suggested that ***novelty***, that is, the age of the actor, constitutes a factor, since new actors have more opportunities to make flexibility a core feature of their operations (Libertson, 2024).

3.4 User profiles

Based on resources and socio-temporal factors, Powells and Fell (2019), and I (see Paper I) have developed four generic user profiles with different levels of flexibility capital (Figure 2), reflecting users' access to material and immaterial resources and socio-temporal facilitation, that is, lifestyles and daily routines that either facilitate or hamper their flexibility.

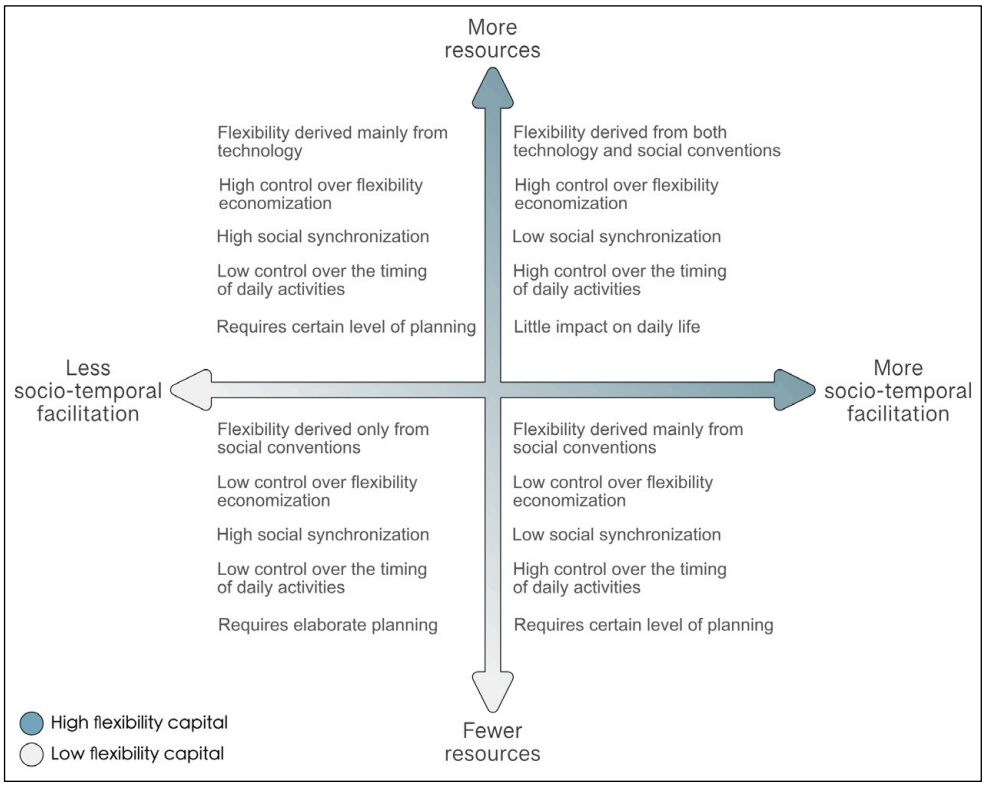


Figure 2
Generalized representation of the effects of access to resources and socio-temporal facilitation on user profiles and their flexibility capital.

Users matching the two profiles in the lower quadrant have fewer resources for being flexible. However, those who fit the profile in the lower right quadrant can still provide some flexibility due to living a more flexible life, whereas the daily lives of those who fit the profile in the lower left quadrant have little scope for being flexible. The social synchronization of those with this user profile is high, meaning that their daily activities are highly dependent on others. In this sense, those fitting the user profile in the lower left quadrant are at a double disadvantage, lacking both resources and social flexibility, with the result that they have little or no flexibility capital. Conversely, the social synchronization of users fitting the profile in the lower right quadrant is low, meaning that they are less dependent on others. This, in combination with a more flexible lifestyle, enables them to be more flexible (Libertson, 2022a).

Users who fit the user profiles in the upper quadrants, on the other hand, have more resources that enable flexibility. Providing flexibility has little effect on their comfort as they have the financial means to pay to avoid discomfort (Powells &

Fell, 2019). Those who fit the profile of the upper left quadrant are, however, hampered by inflexible lifestyles and high social synchronization. Yet their affluence still allows them many opportunities to provide technology-derived flexibility. Lastly, users who fit the profile of the upper right quadrant have the most opportunities to provide flexibility as they possess resources and enjoy a flexible lifestyle with low social synchronization (Libertson, 2022a).

Powells and Fell (2019) highlight how the generalized representation for determining flexibility capital is useful for extrapolating the extent to which those fitting the different user profiles will be able to monetize their flexibility. Users with more resources are to a large extent in control over when and how they can profit from providing flexibility. Conversely, less advantaged users are more dependent on others for monetizing their flexibility. Powells and Fell (2019) also underscore how the flexibility of more affluent users tends to be derived from technology, whereas less affluent users have to make social rearrangements to provide flexibility. In Paper I, I add to this idea by pointing out that flexibility can also be derived from social conventions. Users with more socio-temporal facilitation lead flexible lives, thereby allowing them to provide flexibility derived from social conventions. By contrast, users with less socio-temporal facilitation are constricted by social conventions. Should they want to provide flexibility, they must make social rearrangements. Another way of understanding this is by looking at social synchronization, that is, the level of the coming together of people (Blue et al., 2020). High social synchronicity implies high levels of structuring around and dependence on social relations. Conversely, low social synchronicity entails a fairly independent organization of daily life without the need to take other people into account. In Paper I, I indicate how these insights introduce a paradox for the user profile of the lower left quadrant. On the one hand, their flexibility is constrained by high social synchronization and by their dependence on other people. On the other hand, their main source of flexibility is by making social rearrangements. In this regard, social relations appear to constitute both the problem and the solution.

Taken together, these considerations underscore the initial argument: being flexible is a matter of socio-economic status and social class and thus a potential source of energy inequity. Consequently, organizing the electricity system around user flexibility to maintain energy balance risks creating a more unjust electricity system (Libertson, 2022a; Powells & Fell, 2019).

3.5 Previous research on flexibility capital

To date, five years have gone by since the inception of the flexibility capital concept. Despite being widely referenced, few studies have used the concept as a theoretical framework for analysis. In this subsection, I will provide a brief overview of these studies.

Crawly and colleagues (2021) conducted two user flexibility pilots in areas with low income households in the UK. The two groups of the participants were classified according to their flexibility capital, with the one group having mainly technology-derived flexibility capital and the other having mainly socially-derived flexibility capital. The aim of the study was to investigate how flexibility capital is created, how flexibility is controlled, and to whom it brings value. It was found that there are unique trade-offs between passive (technology-derived) and active (socially-derived) user involvement. In the pilot with technology-derived flexibility, the participants were protected from financial and physical discomfort by the technology that they received from the project. However, the project required more up-front financial investment. The second pilot required less up-front investment, but entailed more financial risk and physical discomfort for the participants.

A number of studies have also investigated how resources and socio-temporal factors influence the flexibility capital. For example, Stelmach et al. (2020) found that households with smart technology, more household members, and less square footage displayed higher willingness to provide flexibility, thereby confirming the relevance of these factors for flexibility capital. Caballero and Ploner (2022) highlighted the significance of financial resources and knowledge when responding to price signals for load-shifting. Their study found a positive correlation between income and ability to respond to signals. White and Sintov (2019) examined the effects of time-of-use tariffs and found that vulnerable users, such as the elderly and disabled, were disproportionately affected by the higher tariffs as they had less ability to time-shift their electricity consumption. These studies thus confirmed, in accordance with the flexibility capital concept, that user flexibility is related to social status.

Ribó-Pérez and colleagues (2021) reported on the significance of home appliances when providing flexibility. Their findings suggest that inequality in household equipment creates a flexibility gap between rich and poor, for affluent users with more smart appliances installed have more opportunities to be flexible in their use of electricity than their less affluent counterparts. Winther and Sundet (2023) also found a correlation between users' attitudes towards user flexibility and their level of affluence. Affluent users were more likely to harbour positive sentiments towards it, whereas less affluent users expressed frustration and negative opinions about being asked to provide flexibility. Johnson (2020) examined how capacities

for flexibility vary within households and underscored the extent to which flexibility is a matter of gender roles. She accordingly argues that the division of household chores in relation to providing flexibility should receive more attention, lest the responsibility for being flexible falls on women.

Other studies have investigated the influence of macro-level factors on flexibility capacity. Savelli and Morstyn (2023) explore how the geographical location of a user determines their flexibility potential, showing that geographical differences can result in unequal opportunities for providing user flexibility. Similar findings on the importance of localization and regional differences were reported by Ribó-Pérez and colleagues (2021).

In my conceptual contribution, I added socio-temporality to the factors influencing flexibility capital. However, other studies have suggested further conceptualizations and different forms of integration with other frameworks. Adams et al. (2021) add to the concept by highlighting how industry and market actors tend to frame flexibility as a resource rather than a capacity. This valuable distinction brings into focus the potential conflicts that may arise between the technical and social dimensions of providing flexibility. A resource is something extractable; at best a resource is free, and at worst there is an economic cost to extracting it. A capacity, on the other hand, is an ability or skill needed to perform a task, which in this instance is providing flexibility. The work done by Adams et al. (2021) shows that 1) being flexible is a matter of skills, 2) being flexible requires continuous work, and 3) there is potential incompatibility between the need for flexibility in electricity systems and the everyday lives of the users, or in other words, between system efficiency (a matter of resources) and daily needs (a matter of ability and skills).

Von Platten (2022a) combined the energy vulnerability framework with the flexibility capital concept in her analysis of heating-related energy poverty. She found that sociodemographic and geographic factors affect the vulnerability and flexibility capacity of users. In doing so, she statistically verified previously assumed correlations in qualitative research about the risks of energy poverty in relation to price variations and providing user flexibility. Fjellså, Ryghaug, et al. (2021) have also explored the overlap of flexibility capital and energy poverty and propose the term ‘flexibility poverty’. Flexibility poor are those users with small means of providing flexibility. This term highlights the overlooked social, structural, and material factors that either limit or enable flexibility. Furthermore, it theorizes that user flexibility may constitute a lock-in for the users. Thus, on a societal level, attempts to rid energy systems of their lock-ins by making the demand more flexible will shift the lock-ins from the system to the user.

Lastly, there have also been studies comparing how industry experts and households understand user flexibility from the perspective of flexibility capital. Fjellså, Silvast, et al. (2021) found that users’ understanding of flexibility differed

from that of experts in that it was based on the activities of everyday life, while the experts' understanding was rooted in neo-classical economics. The same discrepancy was noted in the study by Winther and Sundet (2023).

4.

Mr. Bartleby was very proud of his new titles. Not only did he now have his own consultancy firm, but he could also add entrepreneur, CEO, and founder to his business card. The last couple of months had been rather hectic. Bartleby found this very confusing. The flexibility of freelancing was supposed to make him more efficient and thereby bring him more leisure, and yet, he found himself constantly working overtime. Even more confusing were the declining digits on his bank account. In spite of Mr. Rooster's reassurances that freelancing was a guarantee for financial success, Mr. Bartleby was having trouble keeping up with the bills. His new contract, in which he was being paid per deliverable rather than by the hour, was perhaps not as favourable to him as he had been told.

Meanwhile, Mr. Rooster was mulling things over. The financial success of his flexibility strategy had not materialized. Instead, he now found himself in a corner in which he was compelled to cut costs to maintain the buoyancy of his enterprise. He was so close to fulfilling his dream of making Rooster Consultancy Inc. famous – of this he was certain! All he needed was a little more time and money. If only there was a way to decrease the overhead costs…

"Mr. Bartleby, you are a genius! I knew I could count on you!"

Puzzled, Bartleby looked up from his screen. Today he was using his private computer since the one supplied by Rooster Consultancy Inc. was malfunctioning.

"What have I been thinking?" said Mr. Rooster. "Why should Rooster Consultancy Inc. supply office materials when that money could go elsewhere? You are a role model to us all, Mr. Bartleby! Starting from tomorrow, everyone will be using their private computers for work."

"Yes, sir! Absolutely, sir!" said Bartleby.

"This office is filled with tied-up capital," Mr. Rooster reflected, while greedily scanning the office space and feeling reinvigorated by his new realization.

4 A critical realist's methodology for exploring user flexibility

Methodology constitutes a toolset of strategies and methods for conducting research, which is grounded in the pragmatic assumptions and the scientific field of the researcher (Guba & Lincoln, 1994). In this chapter, I introduce the overall research processes of the thesis. Section 4.1 outlines the research foundations, that is, interdisciplinary research in the inquiry paradigm of critical realism designed as a multiple methods research project, while section 4.2 describes the methods of data collection and analysis. The chapter concludes with a reflection on the methodology, the reliability and validity of the research, and ethical considerations.

4.1 Research foundations

4.1.1 Interdisciplinary research

Sustainability science seeks to solve the problems of climate change, which are the results of the unsustainable interactions between human and biophysical systems across temporal and physical domains. As such, sustainability science constitutes a form of applied research and action research in that its purpose is to generate potential solutions (Patton, 1990) while also being a part of the change process. However, the complexity of climate change calls for a holistic approach that integrates disciplines and different forms of research, such as interdisciplinary research (Jerneck et al., 2011; Stock & Burton, 2011). Interdisciplinary approaches are the bridging of disciplinary viewpoints to address real-world problems. Integrating disciplines entails combining ideas from natural and social science to find joint problem framings and common methodological grounds (Stock & Burton, 2011).

As with sustainability science, energy research aimed at addressing sustainability issues requires multiple perspectives (Sovacool et al., 2018). Energy research covers a wide range of topics that intersect the technologies, resources, behaviours, and policies that constitute the socio-technical systems of energy provision. As such, energy research applies interdisciplinary approaches that combine methods and

concepts for investigating the social and technical domains of energy systems and sustainability (Sovacool, 2014).

This thesis addresses sustainability issues of systems of energy provision, and in so doing it constitutes a work of interdisciplinary research. The thesis brings together aspects of different research fields, such as time geography, social practice theory, socio-technical narratives, and social justice theory, in order to improve knowledge on user flexibility from an energy justice perspective. This thesis is also a work of interdisciplinary collaboration. The CLUE research project (CLUE, n.d.) that this thesis was a part of, entailed collaborations between both academic and non-academic actors across several sectors and countries.

However, interdisciplinary research also comes with certain implications, as the integration of disciplines entails questioning the past ontological, epistemological, and methodological boundaries of each discipline. Historically, each research discipline has had a unique inquiry paradigm for understanding the world, for understanding knowledge, and methods for obtaining knowledge. These inquiry paradigms are in some respects at odds with each other. Thus, interdisciplinary approaches must also seek to reconcile these past differences and find a common middle ground (Stock & Burton, 2011).

4.1.2 Inquiry paradigm

As this thesis takes an interdisciplinary approach, it constitutes an attempt to bridge the objective positivistic standpoints and the subjective constructivist standpoints that come with research that scrutinizes societal structures of inequality and underlying cultural assumptions (Sovacool & Hess, 2017). In doing so, I position myself somewhere between positivism and constructivism, that is, somewhere between the belief in an objective external reality and the assumption that several, apprehensible, and sometimes contradictory social realities exist. The inquiry paradigm that best aligns with this standpoint is called critical realism (Bhaskar et al., 2010), which is reflected in my ontological, epistemological, and methodological considerations (Guba & Lincoln, 1994).

Critical realism attempts to negotiate between the insights of positivism and constructivism, whilst also trying to avoid their pitfalls. Critical realism is arguably grounded in a positivist tradition that views the world as separate from human consciousness. However, critical realism also recognizes certain elements of the constructivist tradition, such as the influence of subjective perspectives and limitations in understanding the true nature of the world. In other words, the world in which the researcher exists and their knowledge about it are inseparable (Danermark et al., 2019; Elder-Vass, 2022). I believe that critical realism is the most appropriate ontological label for the thesis since it contains both positivistic and constructivist elements. Positioning myself in the paradigm of critical realism

implies that I assume that an observable reality exists, while at the same time, I recognize that reality to a certain extent is defined by the temporal and cultural dimensions of the observer and the observed (Danermark et al., 2019; Guba & Lincoln, 1994). This position is reflected in the thesis in that I assume that there is an ideal state that society should strive for (i.e., energy justice), whilst also acknowledging that energy futures to some extent are shaped by individual norms and values.

The resemblance of both positivistic and constructivist traditions is particularly prominent in the epistemological derivations of critical realism. The object and the researcher are no longer considered to be fully separate entities (Danermark et al., 2019). Positioning myself in the paradigm of critical realism means that I no longer believe that dualism, that is, the assumption that the researcher can independently investigate an object without neither influencing nor being influenced by the object, is possible to maintain. However, I still hold objectivity as a 'regulatory ideal' in that the research must pass critical examination, such as reviews by experts, scrutiny by professional peers, and juxtaposition to previous knowledge (Guba & Lincoln, 1994). This epistemological standpoint implies that I recognize that my understanding of knowledge changes over time. My methods of data collection and analysis that I applied when I began my research might therefore have looked somewhat different had I done them today.

From critical realism follows a modified experimental approach to methodology. By using triangulation, or 'critical multiplism', the researcher seeks to falsify the hypothesis rather than verify it (Guba & Lincoln, 1994). By positioning myself in the paradigm of critical realism, I place more emphasis on the context of the research and the inclusion of meaning and purpose of human behaviour, by conducting the research in natural settings, collecting situational data, and ascribing meaning to subjective and individual experiences. This methodological position is reflected in the thesis in that I explore how various actors understand user flexibility in their natural settings in order to deduce the potential energy justice implications of user flexibility. I also recognize that this position means that I acknowledge that using other informants might have produced different results. I am open to the possibility that other actors might have a different view than the actors from whom I have collected the empirical data; however, since I analyse trends and patterns in the material the results go beyond individual perceptions and contribute to more general knowledge.

4.1.3 Research design

The research design is the procedures and the strategies for conducting research (Creswell, 2014). It is the logical sequence of steps that poses the research question, acquires the empirical data, and ultimately results in a conclusion. Typically, the research design deals with four problems: a) how to define the research questions,

b) how to identify relevant data, c) how to acquire relevant data, and d) what methods to use for the analysis (Yin, 2018). This thesis constitutes a multiple methods research design, and as such it addressed the four problems in various ways. A multiple methods research design entails an approach that includes two or more studies that use different methods, and where the studies either address the same research inquiry or different aspects of the same research inquiry. This implies that each study in a multiple methods research project is an independent entity and may be published as a stand-alone study (Papers I–IV). The final report of the multiple methods research project then synthesizes the results from each study in order to answer the overall research question (the thesis) (Tashakkori & Teddlie, 2010). This thesis utilizes various research methods, such as conceptual review (Paper I), literature review (Paper II), case study (Papers III–IV), and mixed methods (Paper IV) to address the potential energy justice implications of user flexibility.

This thesis employed ***literature reviews*** as a research method for comprehensively analysing and synthesizing the existing body of knowledge (Efron & Ravid, 2019). By situating each paper within their broader context provided by the literature reviews, I aimed to justify their relevance and significance (Jesson et al., 2012). The structure and approach of the literature reviews varied depending on the objectives and scope of the papers (Efron & Ravid, 2019; Jesson et al., 2012). I utilized a systematic review, characterized by rigorous search protocols, in Paper I to review the ongoing national energy discourse in Sweden in public news media. This method was chosen for Paper I as it was deemed the most appropriate to thoroughly examine and summarize the debate, as well as justify the scope of the thesis (Jesson et al., 2012). In Papers III and IV, I employed narrative reviews, which are less structured and allow for the evolution and reformulation of the research scope over time. This method was chosen as the purpose of Papers III and IV was not to encompass every publication but rather to explore and present a diverse understanding of their respective topics (Efron & Ravid, 2019). Conceptual reviews are similar to literature reviews in that they summarize previous research; however, they also go beyond that scope in that they seek to improve on an existing theory or concept by integrating two or more theories (Gilson & Goldberg, 2015; Jaakkola, 2020). I used a conceptual review in Paper II, as this research method was deemed the most appropriate to expand on the concept of flexibility capital. Although an appropriate method for improving an existing theory, its application proved also somewhat difficult since it meant integrating and retrofitting studies based on other frameworks.

Case studies comprise a research method for in-depth explorations of programs, events, activities, or processes with very distinct temporal and procedural boundaries (Creswell, 2014; Gerring, 2017). By using case studies as a method in Paper IV, I aimed to generate in-depth insights into user flexibility in the charging of electric vehicles and how that affects the users. Case studies are particularly

useful for asking questions about the 'how' and the 'why', i.e., questions that seek to explain complex social phenomena and contemporary events, such as group behaviour, organizational processes, and effects on everyday life (Yin, 2018). However, due to several external factors, such as the pandemic, requirements by the other CLUE project members, and technical issues, I was unable to explore user flexibility in the charging of electric vehicles as deeply as I would have liked. Case studies was also used in Paper III to explore how industry experts understand and conceptualize user flexibility.

Mixed methods is a complete method in itself (Tashakkori & Teddlie, 2010). Mixed methods is a single project that includes the collection and integration of both qualitative (open-ended) and quantitative (closed-ended) data (R. B. Johnson et al., 2007). This thesis used mixed methods in Paper IV to explore user flexibility in the charging of electric vehicles and the ways in which it may affect the users. The benefit of using both qualitative and quantitative methods of exploring a phenomenon is that each dataset provides a validity check for the other. However, integrating datasets implies a merger, which may prove difficult depending on the extent to which the datasets are uniformly thematized (Creswell, 2014). Paper IV utilized a convergent parallel mixed methods design (Figure 3). Convergent parallel design entails collecting and analysing quantitative and qualitative datasets separately, followed by a merger and comparison (Creswell, 2014; Tashakkori & Teddlie, 2010).

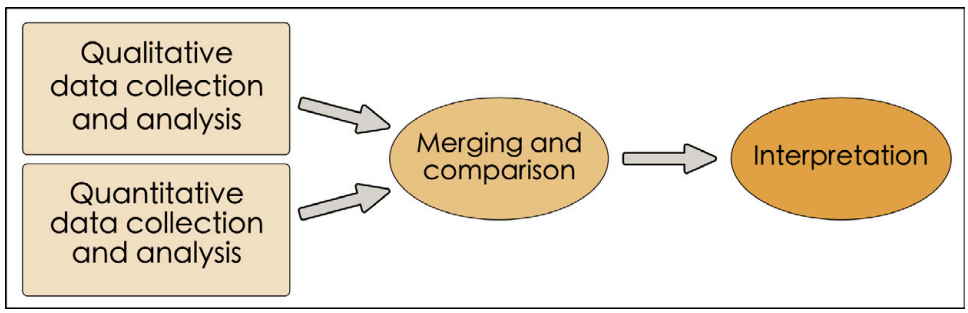


Figure 3
Convergent parallel design. During interpretation, areas of convergence or divergence between the qualitative and quantitative data are discussed.

Although this thesis contains both qualitative and quantitative elements, the research design is mainly of a qualitative nature. Qualitative research is commonly presented as adequate for exploring natural events in their own setting, revealing complexity to give thick descriptions, identifying the meanings of people that they place on the social world, and developing hypotheses (Miles et al., 2014). The primary interest

of qualitative research is to seek illumination, understanding, and extrapolation to similar situations (Golafshani, 2003). As this thesis seeks to *explore* user flexibility and how various stakeholders make sense of user flexibility within the energy transition in order to *understand* the potential energy justice implications, a qualitative research approach was deemed the most appropriate.

4.2 Research methods

4.2.1 Methods for data collection

This thesis employed a variety of methods for data collection, namely database searches for the literature reviews (Papers I–IV), case studies (Papers III–IV), interviews (Papers III–IV), and surveys (Paper IV).

Database searches

Conducting any type of literature review generally entails database searches. Due to the ever-growing number of publications and databases, Efron and Ravid (2019) suggest keeping a record of every activity in the process to ensure traceability and efficiency. This advice was followed throughout the thesis project. This thesis consulted mainly four databases for the research, namely Google Scholar, Scopus, Web of Science, and Retriever, an international database with printed and digital media from the Nordic countries. Google Scholar was generally used for quick searches, whereas Scopus was consulted for more detailed searches. Scopus was considered the most relevant database for this thesis since it gathers a majority of the energy research of the social sciences. Web of Science was used for complementary searches to account for any relevant research that might have been left out by the other databases. Retriever was used for retrieving printed and digital news articles. The database searches were conducted by applying Boolean operators to a combination of keywords and subjects, in order to focus the scopes and to retrieve relevant publications (Efron & Ravid, 2019; Jesson et al., 2012).

In Paper I, the data for analysing the ongoing national energy discourse in Sweden was found via Retriever. I employed criterion sampling in order to include news coverage and op-eds from both national and local newspapers from the regions affected by grid congestions (Stockholm, Gothenburg, Uppsala, and Malmö and their surroundings). Criterion sampling is used when the goal is to review all instances that meet a set of specific and predetermined criteria (Flyvbjerg, 2006; Patton, 1990). Three separate database searches were made to retrieve news articles on the topic published between 2010-2020, by using the keywords ‘power shortage’, ‘electricity shortage’, and ‘capacity shortage’ (in Swedish: ‘effektbrist’, ‘elbrist’,

'kapacitetsbrist'). The initial sample amounted to 1083 news articles that were subsequently narrowed down to 312 items after removing duplicates and unrelated content. The sample was also designed so as to jointly represent the full political spectrum (maximum variation sampling). Thus, the final sample comprised eight daily newspapers, the national news bureau, and a weekly magazine on energy, transport, and life science.

The data collection in Paper II comprised literature searches that were conducted by use of Scopus, Web of Science, and Google Scholar. Two searches were conducted. The first search aimed at summarizing all previous literature on the flexibility capital concept (criterion sampling). This was done by reviewing all citations to the original article on flexibility found via Google Scholar ($N = 77$). In the second literature search, I employed extreme case sampling and critical case sampling as sampling criteria to find previous studies on user flexibility with concrete examples of how flexible electricity uses affect everyday life. Extreme case sampling is used for obtaining information that is unique in some regards in order to learn about unusual conditions. Critical case sampling is used in order to make logical generalizations about a particular phenomenon. Critical cases are those instances that have strategic importance for a particular problem (Flyvbjerg, 2006; Patton, 1990). The literature in the second database search was found by use of several search strings (Table 3). The final sample of the second search amounted to 20 pilot studies on user flexibility.

Table 3
List of search strings Paper II.

Data base	Search string	Filter
Scopus; Web of science	'Social practice' AND energy AND flexibility AND temporality	Article; Review
Scopus; Web of science	'social practice' AND flexibility AND temporality	ENERGY; Article; Review
Scopus; Web of science	Practice AND energy AND flexibility AND temporality OR time-shifting OR 'temporal flexibility'	ENERGY; Article; Review
Google Scholar	'socio temporal' AND 'energy use'	-

Case studies

Collecting data from case studies begins with defining the case (geographically and procedurally) and bounding the case (temporally) to determine the units of analysis (Yin, 2018). These delineations were already decided upon by the Swedish CLUE project members. The case study that formed the basis for Paper IV was a collaboration between local stakeholders that included Malmö municipality, Malmö

parking company, the regional distribution system operator, and Lund University. The units of analysis were electric vehicle users, and user flexibility in electric vehicle charging was explored through their experiences and perspectives. The sample constituted a critical case since the goal of the study was to make logical generalizations about user flexibility in electric vehicle charging (Flyvbjerg, 2006; Patton, 1990).

The case study carried out and monitored three different use cases related to user flexibility in charging. Each use case lasted 14 days and was conducted in two parking garages in Malmö. The participants were informed about the ongoing pilot in the first garage but not in the second. The purpose of this design was to account for any potential bias in the first garage (Yin, 2018). The methods of data collection comprised interviews, surveys, and documentation of charging statistics (more on this below).

Interviews

Fundamental to social science, is the interview as a method for collecting empirical data. Interviews are the method by which social scientists gain insights into the opinions, values, attitudes, feelings, and experiences of people (May & Perry, 2022). Interviews can take many forms, ranging from highly structured and standardized, to semi-structured and thematic, to unstructured and free-flowing conversations. Regardless of form, interviews entail an interactional exchange and an in situ product (Holstein & Gubrium, 1995). Thus, interviews constitute a site of knowledge in which the researcher may explore the ways in which people understand and experience their world (Brinkmann & Kvale, 2018).

Interviews formed the basis of data collection in Papers III and IV. In Paper III, semi-structured interviews were used in order to probe the prevailing narratives of industry experts regarding user flexibility (Kvale & Brinkmann, 2015). The interviews were structured around different themes of user flexibility and the energy transition. The sample constituted actors within the energy sector ($N = 13$), who were purposefully selected by use of maximum variation sampling to cover the central themes of the inquiry. Maximum variation sampling is employed when the purpose is to identify central themes within a heterogeneous group (Patton, 1990). The actors were selected based on their experience of working with user flexibility programs and other solutions to grid congestions. The respondents representing the industry actors were in turn selected through purposive sampling and snowball sampling ($N = 24$). Snowball sampling is a method of sampling in which the sample is expanded by use of the networks of the subjects in the initial sample (Flyvbjerg, 2006; Patton, 1990). The respondents were chosen based on their professional roles in the organization, such as sustainability coordinators and flexibility strategists.

Semi-structured interviews were also used in Paper IV in order to gain insights into how electric vehicle users understand and make sense of user flexibility and its relation to the energy transition (Brinkmann & Kvale, 2018). The interviews were based on a set of themes pertaining to different attributes of user flexibility (Patton, 1990). Twenty-seven respondents were handpicked from the case study by use of maximum variation sampling (Patton, 1990), to account for gender and age variations.

Surveys

Also fundamental to social science for gathering data is survey methodology (Groves et al., 2009). Surveys were employed as they constitute a systematic and effective means of acquiring information about the characteristics and attributes of a large population (May & Perry, 2022). The purpose of surveys is to construct quantitative descriptors in order to understand the size and distributions of the characteristics within a population (descriptive statistics), as well as the relation of two or more characteristics (analytic statistics) (Groves et al., 2009). The class of surveys used in this thesis was attitudinal, as the surveys enquired into how electric vehicle users perceive user flexibility in charging.

Three surveys (Table 4) were distributed during the research of Paper IV: one inquiring into the experiences from the first garage, one inquiring into the experiences from the second garage, and one general survey on user flexibility in electric vehicle charging. All respondents were found by use of the customer database of the distribution system operator. The first and the second surveys were sent to the customers who had participated in the use cases (criterion sample). The third survey was sent to all customers living in the region of Stockholm and the region of Malmö (criterion sample).

Table 4
Survey response rate of Paper IV.

No.	Survey	Respondents	Sample size	Response rate
1	Garage A	24	92	26 %
2	Garage B	31	76	31 %
3	General	1428	5710	25 %

4.2.2 Methods for data analysis

This thesis employed qualitative content analysis and quantitative statistical analysis as methods for data analysis.

Qualitative content analysis is the process of systematically describing the meaning of qualitative material (Schreier, 2012). Qualitative content analysis was used for analysing the material from the interviews and the literature reviews. The process consisted of three concurrent phases: a) data condensation, b) data display, and c) conclusion drawing and verification. Data condensation entailed a process of continuously strengthening the data by selecting, simplifying, abstracting, and synthesizing the raw data, in which later stages also included coding and thematization. Data display entailed organizing the data in ways that allowed for conclusion drawing, such as extended text and matrices. Conclusion drawing and verification entailed an interpretation of the data by identifying patterns, explanations, and propositions, in ways that were meaningful and valid and that tested the plausibility of the conclusions (Miles et al., 2014).

The ***data condensation*** began with a close reading of the material, followed by coding. Coding is a form of analysis in itself in which I assigned labels to descriptive or inferential parts of the collected information (Brinkmann & Kvale, 2018). The coding was commonly performed in two rounds, where the first round concerned identifying and labelling important segments of the information, and the second round concerned clustering the segments in order to identify patterns (Miles et al., 2014). For example, in Paper I prominent themes were identified and catalogued in the newspaper articles, such as the nature of the argument, how the problem of the grid congestion was portrayed, and the types of solutions that were proposed to remedy the situation. Based on this reading, the articles were then classified as belonging to either the centralized or a decentralized narrative. In Paper III the first round of coding was descriptive and concentrated on the content of the respondents' answers ('the what') and the second round was analytical and focused on the construct of the answers ('the how') (Ballo, 2015).

Data display can take several forms (Miles et al., 2014). This thesis applied data matrices to display the collected information. A matrix can best be described as an intersection of lists with rows and columns for organizing the coded material (Miles et al., 2014). Each cell contained an abstraction of the data. Thus, when reading the matrix horizontally or vertically, I was able to deduce patterns based on the abstractions and draw second-order generalizations about the larger picture. For example, in Paper III, four archetypes with coherent narratives were created through an iterative process where the discursive elements were first clustered and then contrasted by use of the matrix (Miles et al., 2014).

There are several tactics for ***conclusion drawing and verification***, such as searching for patterns and themes, contrasting, comparing, clustering data, and making numerical accounts (Miles et al., 2014). In this thesis, I present the conclusions as an analytical text and narrative, which highlights the features of the data and interweaves them into coherent understandings (Schreier, 2012). During the conclusion drawing and verification, I employed an inductive approach to the data analysis. This entailed a process of extrapolating interpretations from an observed

subject (e.g. electric vehicle users) to a class of subjects (e.g. energy users), in order to draw general conclusions about the class (Brinkmann & Kvale, 2018; Yin, 2018).

Quantitative statistical analysis is a process for understanding the characteristics of the data (descriptive statistics) and the relationship of the characteristics (analytic statistics) (Groves et al., 2009). The relationship of the characteristics may be tested through various forms of regression analysis (Treiman, 2009). This thesis employed Mann-Whitney U tests, Kruskal-Wallis H tests, and Spearman's rho tests for the analytic statistics. Mann-Whitney U is used to test for statistically significant differences between two independent groups when the dependent variable is either ordinal or continuous. Kruskal-Wallis H is a form of extended Mann-Whitney U test in that it can test for statistically significant differences between more than two groups when the dependent variable is either ordinal or continuous. Lastly, Spearman's rho is used to measure the strength of association between two variables measured on at least an ordinal scale (Treiman, 2009).

4.2.3 Reliability and validity

Regardless of the nature of the research, reliability and validity are fundamental in both qualitative and quantitative research in order to establish and demonstrate credibility (Sovacool et al., 2018). However, the historical dominance of quantitative research in science has led to the imposition of quantitative research standards for testing for credibility of qualitative research. Due to the (often) paradigmatic differences in assumptions of quantitative and qualitative research, the application of the standards of the former on the latter may prove irrelevant at best and inadequate at worst. Instead, reliability and validity should be redefined in order to reflect the ways in which qualitative research establishes truth (Golafshani, 2003). For example, instead of ensuring replicability and accuracy as in quantitative research, qualitative research should seek to safeguard trustworthiness, rigour, and transferability (Golafshani, 2003; Tracy, 2010). Trustworthiness refers to establishing confidence in the results to the extent that they are deemed defensible (Golafshani, 2003). Rigorous research entails the use of sufficient and appropriate theoretical constructs, time in the field, sample, context, and processes of analysis. Transferability is the value of the research in other contexts or situations, which may increase by the use of direct testimonies, rich descriptions, and accessible writing (Tracy, 2010). In addition, triangulation has been proposed to enhance the credibility of qualitative research further (Patton, 1990; Tracy, 2010), which can mean both the process of using several types of methods or data (Tracy, 2010) and involving several researchers in order to arrive at the same conclusion (Golafshani, 2003).

As aforementioned, the majority of research in this thesis is of a qualitative nature. Thus, in order to provide a meaningful reflection on the quality of the research, I

believe that the most fruitful approach is to discuss reliability and validity in terms of trustworthiness, rigour, transferability, and triangulation.

In order to promote rigour, the research processes have been described in detail, as well as their rationale and their approach. The details regarding data sources and databases, the search terms used and the criterion for inclusion, the demographic details of the respondents, interview details, the sizes of the samples, modes of analysis, and the timelines of the research have been described as clearly as possible. The quality of the survey was strengthened by collecting an appropriate sample size. The survey was carefully designed with the help of experts and distributed with a professional survey tool. The analysis of the qualitative data was carefully designed based on the research questions and available data.

Describing the research in detail has also promoted transferability. This research has sought to provide as rich descriptions as possible in order to increase its value in other contexts. Throughout the process, triangulation has also been employed. Each paper constitutes a unique source of data and method of data collection. The juxtaposition and merging of Papers I–IV imply an assessment of the extent to which the data points in the same direction, that is, a form of triangulation. Overall, the rigour, the transferability, and the triangulation amount to enhancing the trustworthiness of the thesis, as they jointly establish confidence in the results.

4.2.4 Ethical considerations

Doing any type of research implies the risk of instrumentalizing the research subjects to some extent, which at worst can lead to people being used for others' ends. Research must thus be guided by a set of ethical principles and considerations in order to avoid doing harm (Miles et al., 2014). These considerations include, but should not be limited to, a) informed consent, b) privacy, confidentiality, and anonymity, and c) ownership of data (Brinkmann & Kvale, 2018; Creswell, 2014). These considerations were addressed in the following ways:

All participation in this research project has been voluntary. During the initial contact with the presumptive participants, they were informed that their participation would be fully voluntary, and the intent of the research was fully disclosed. The presumptive participants were also informed about the type of personal data that was to be collected, the purpose of the processing for which the personal data was intended, the ways in which the personal data would be processed and stored, and the identity and contact details of the researcher in accordance with the EU General Data Protection Regulation (GDPR). The information about the research project and the data management was made as accessible as possible by using clear and concise language and by avoiding the use of professional jargon.

The collected interview material (audio recordings, video recordings, and notes) was pseudonymized, and potentially identifiable characteristics or associations with

organizations were removed. During the pseudonymization process, the respondents were also given a code and a number and were referred to in the research as 'Respondent #xx'. The names of companies or organizations that the respondents represented were not disclosed in the research. Instead, they were referred to by their function, such as transmission system operator and distribution system operator. All data is stored on the servers of Lund University, and the keys to the personal data and the data itself have been stored at separate locations.

None of the data collected via interviews in Paper III and via surveys and interviews in Paper IV included any sensitive personal data as defined by the GDPR. Neither did the data collection cause any harm or burden to the respondents as defined by the Swedish Ethical Review Act. Nevertheless, the research was carefully designed so as to avoid any potential risks. Furthermore, the research project also closely followed the guidelines of The European Code of Conduct for Research Integrity to account for the potential ethical implications of collecting, processing, and storing of data.

Prior to commencing the case study in Paper IV, in which the charging of electric vehicles would be controlled by an external operator, a discussion was held among the project partners about the ethical implications of the case study. Controlling the charging would inevitably mean a form of physical interference that may lead to inconveniences for the participants. Another ethical aspect of the case study was the inclusion of uninformed trials. Of course, deception should always be avoided if possible. However, when designing the case study, the aim was to strike a balance between non-biased data and the comfort of the participants. The control group was deemed necessary as the knowledge of controlled charging may be more frightening than the actual effects. The CLUE project partners had previously observed that only by communicating a coming change, the participants would automatically change their behaviour. The controlling of the charging and the uninformed trials were deemed acceptable as they were within the boundaries of the business contract between Malmö parking company and its customers (i.e., the participants). According to the contract, Malmö parking company has no obligation to deliver more power than what is available, and they have full discretion to control the charging based on availability. As such, the customers are not guaranteed full/22 kWh charging, only up to 22 kWh. During the trials, the charging power never went below 50% of the capacity to avoid overly affecting the comfort of the participants.

4.2.5 Methodological reflections

Throughout this chapter, I have provided arguments for the research design and the methods of the thesis. The complexity of sustainability issues and the intricacy of matters related to systems of energy provision called for an interdisciplinary research approach that integrated disciplines. This approach allowed me to explore different fields and learn from different ideas in my pursuit of addressing the social

and technical domains of energy systems and sustainability. The qualitative research design granted me an in-depth exploration of user flexibility and the ways in which various stakeholders make sense of user flexibility within the energy transition. This research approach was deemed the most appropriate as the research aim was to understand the potential energy justice implications of user flexibility. The application of multiple research methods, such as conceptual review (Paper I), literature review (Paper II), case study (Papers III–IV), and mixed methods (Paper IV), enabled a thorough examination of the potential energy justice implications of user flexibility from multiple perspectives, whilst also strengthening the quality of the research results. In conclusion, I believe that the methodological considerations I have made have been pragmatic and to the best of my ability.

Nevertheless, I would like to take this opportunity to reflect on what could have been. Doing research commonly involves several considerations and decisions, some of which may be active choices by the researcher while others are the result of circumstances. My doctoral studies were no different. The flexibility capital concept forms the basis of this thesis and I wish I could say that this was my plan all along. But alas, I discovered the flexibility capital concept 18 months into my doctoral studies, and by that time I had already published Paper II and collected the data for Paper IV. This meant that flexibility capital as a theoretical framework to some extent was an afterthought in the analysis of the empirical material in Paper IV. Had I known about the flexibility capital concept earlier in my doctoral studies, I would likely have designed the research of Paper II somewhat differently with a greater focus on flexibility solutions and user capacities for remedying the grid congestion. Overall, discovering the flexibility capital concept earlier would have meant a more focused and coherent thesis.

As aforementioned, my doctoral studies were a part of the CLUE project. As such, my research was subject to both opportunities and limitations presented by the project. This was particularly evident in Paper IV. On the one hand, the project entailed access to a large customer database of electric vehicle users and to survey tools for easy distribution of the survey. On the other hand, the customer database may also have influenced the sampling since there is no way of knowing the extent to which the customer base was representative. Furthermore, the final versions of the surveys were the result of a negotiation between the project partners. I am thankful for their input, but it also hindered me from asking certain questions. This, in combination with my limited understanding of quantitative methods, resulted in limited data. The surveys were designed in a way that did not allow for a regression analysis with multiple independent variables, which would have been preferable to strengthen the inference further. If I had the chance to redo the survey today, I would have designed it differently.

As mentioned in Chapter 1, my research was also subject to the Covid 19 pandemic. The social distancing restrictions that were mandated rendered the initial plans unfeasible. Originally, the data collection of Paper IV was supposed to also include

participatory observations in addition to the interviews and the surveys. Participatory observations would have captured the direct reactions and responses of the participants. Ultimately, this could have contributed to a more nuanced and much richer material.

Lastly, I would like to address the broader scope of energy justice research. Assuming that the logic of Illich's (1979) arguments in Chapter 2 is sound, in which he links the indefinite expansion of energy use to ever-increasing social inequity, the only reasonable means of addressing energy injustices is by introducing energy sufficiency. Understanding the concept of energy sufficiency implies juxtaposing it with the concept of energy efficiency (Princen, 2003). Energy efficiency is the measures that seek to maximize the output of a process while minimizing the energy input of the process, i.e., doing more with less (Patterson, 1996). While energy efficiency is at the core of sustainability by arguing for a more efficient use of resources, it says nothing about the total amount of resources used. This means that an efficient energy system can still be highly intense in resources (Darby & Fawcett, 2018; Princen, 2003). Energy sufficiency, on the other hand, mandates an absolute limit to the total amount of energy consumption by defining how much is 'enough' and how much is 'too much' (Burke, 2020; Thomas et al., 2019). In doing so, energy sufficiency addresses the planetary boundaries by defining a safe operating space for humanity – the 'floor' that the societal foundation rests upon and the 'ceiling' that the planetary boundaries amount to.

Framing energy uses in terms of 'too much' and 'too little' prompts a closer examination of the unequal levels of usage worldwide and the uneven distribution of benefits and burdens (Burke, 2020). The idea of an unsurpassable limit to energy use will inevitably lead to a discussion about fairer allocation. Thus, I believe that future energy justice research, mine included, to a larger extent should focus on the contributions of indefinite uses of energy to energy injustices.

5.

William Rooster was in high spirits. He had finally made it – Rooster Consultancy Inc. was about to go public. Smith & Smyth were now onboard as investors, and with their financial assets and influential networks the killing was as good as made. Although, a few concessions had been necessary. For instance, Mr. Rooster had been compelled to resign as a CEO and hand all matters related to management on to Smith & Smyth. Overall, however, these sacrifices were small in comparison to what may lie ahead, and judging from the efficiency and productivity with which Smith & Smyth rose to the occasion, Mr. Rooster was convinced that his enterprise was in good hands:

"We must rationalize the company," said Mr. Smith.

"The company must be rationalized," said Mr. Smyth.

"Naturally," said Mr. Rooster.

"We live in a digital era," said Mr. Smith.

"The digital era is the age in which we live," said Mr. Smyth.

"Physical assets are a waste of financial resources," said Mr. Smith.

"Financial resources should not be wasted on physical assets," said Mr. Smyth.

"My exact opinion as well, good sirs," said Mr. Rooster.

"Rather than a centralized company, Rooster Consultancy Inc. should be decentralized," said Mr. Smith

"Rather than a physical hub, Rooster Consultancy Inc. should act as an online platform," said Mr. Smyth.

Bartleby was labouring away at his desk. It was past midnight and the mumbling voices in various accents, transmitted to him via the online meeting, had a lulling effect.

"Darling, it's late." Mrs. Bartleby emerged from behind the door to Mr. Bartleby's home office.

"Mm…"

"Darling, time to stop working."

"No…," said Bartleby while trying to hear what they were saying in Japan.

"I don't like these new ungodly working hours," said Mrs. Bartleby. "I'm calling your employer first thing in the morning!"

"I'm my own employer…," Bartleby informed her.

"Well, Smirk & Smirch or whatever their names are," Mrs. Bartleby snarled.

"They're not employers, they're job opportunity providers… new strategy…," said Bartleby.

"And what in the blazes is that supposed to be good for?" inquired Mrs. Bartleby.

"Efficiency and productivity…," said Bartleby.

5 An exploration of user flexibility

In this chapter, I present the findings from my research in order to provide insight into how the public news media (Paper II), the energy sector (Paper III), and users (Paper IV) perceive user flexibility. However, before delving into my findings, I give a brief historical overview of the energy market deregulation in 1996 (section 5.1). Once this background has been established, I introduce the media discourse (section 5.2) to examine how user flexibility fits into the narratives of energy futures. User flexibility is often discussed in conjunction with other interventions that seek to make more efficient use of the existing power infrastructure, thereby minimizing environmental impact. Thus, user flexibility is often associated with terms such as 'renewable energy', 'decarbonization', and 'sustainability', and so conceived of as something good and desirable for society. After having examined the different narratives of energy futures, I show how experts within the energy sector regard user flexibility (section 5.3). Their opinions range from somewhat doubtful to highly positive. Lastly, I present the lived experiences of end users to provide yet another perspective on user flexibility (section 5.4). The users in this study are electric vehicle users who participated in a smart charging programme. Although enthusiastic about the prospects of contributing to grid stability, they also expressed concern about how this new way of using electricity would affect their daily lives. As the results in sections 5.3 and 5.4 show, the understanding of user flexibility of industry experts and end users aligns to a large extent with the positive associations of user flexibility seen in public news media.

5.1 A brief historical overview of the Swedish energy sector

The major overhaul of Sweden's energy market when it was deregulated in 1996 is important for understanding the development of the Swedish energy sector. Following a century of rapid expansion in which the demand for electricity doubled almost every twelve years, the growth of the energy sector ground to a halt at the end of the 1980s (Kaijser & Högselius, 2019). This levelling off has been attributed to the complete electrification of every possible market sector – from lightning and power to cooking and heating – leaving the energy sector with very little room for further expansion. However, despite this, the system continued to evolve and grow

economically, as the organizational changes that followed showed. Rather, the deregulation was not a response to the energy market's inability to grow and expand physically but the result of it; a shift that was further boosted by other contemporary changes, such as the acceleration of information and communication technologies, global trends in internationalizing energy markets, the integration of Sweden into the European Union in 1995, and the emergence of neoliberal thinking in Swedish politics (Högselius & Kaijser, 2007, 2010).

The overarching idea behind the 1996 reforms was that a less regulated market would increase efficiency by letting market mechanisms govern future investments, production, and consumption (Högselius & Kaijser, 2007). Changing the overall focus of the energy sector from public welfare to self-interest would guarantee continued low electricity prices and prepare the sector for the forthcoming internationalization, it was argued (Damsgaard & Green, 2005; Högselius & Kaijser, 2007; Tangerås, 2019). The reforms entailed two major changes: the abolition of local and regional monopolies and the creation of an international electricity trading market. Previously, consumers had been reliant on a single local electricity company, and these companies had in turn been reliant on a single regional power producer. The deregulation broke up these monopolies, allowing consumers to choose their supplier. The deregulation also led to internationalization of the energy market as Sweden joined Norway in what became the world's first international electricity trading market, Nord Pool, which enabled producers, consumers, and traders to buy and sell electricity on market terms (Damsgaard & Green, 2005; Högselius & Kaijser, 2007).

Whether the deregulation was beneficial to the Swedish energy system has been debated (Tangerås, 2019). Since 1996, the price of electricity has increased, but this increase should not be attributed solely to deregulation; rather, it should be regarded as the result of a set of external factors (Brännlund et al., 2012). Initial analyses indicated that the deregulation was beneficial for customers as they paid lower prices than they would have otherwise (Damsgaard & Green, 2005). Investigations have also shown that the overall system costs were decreased by deregulation (SOU, 2017). What I find interesting, and what I believe is important for understanding the current trend in user flexibility, is that deregulation enabled the continued economic growth of Swedish energy utilities despite the stagnation in demand (Högselius & Kaijser, 2007, 2010), as well as shifting responsibility and accountability from the public sector to the private sector.

5.2 Understanding the Swedish energy discourse

Examining public discourses is helpful for understanding a society's beliefs about what is right or wrong, desirable or undesirable (Ballo, 2015; Jasanoff & Kim, 2009), and for revealing the underlying norms and values (Kuchler & Bridge, 2018; Tidwell & Tidwell, 2018) that influence its policies and decision-making, and drive its development (Mohan & Topp, 2018; Skjølsvold & Lindkvist, 2015). The ongoing energy discourse in Swedish media can only be described as polarized between conservative and progressive parties. This dichotomy is far from unique to the energy sector. Indeed, it is rather a reflection of society at large. On the one side are those who wish to preserve the centralized structures of the current energy system, albeit with some reforms. I call this the centralized narrative. They support conventional means of large-scale power generation such as nuclear power. On the other side are those who believe that the energy system must be transformed into a decentralized structure in order to cope with both short-term and long-term challenges. I call this the decentralized narrative. Their arguments are associated with modern forms of renewable energy production such as wind and solar power. The reason for making this dichotomous classification is the innate polarization of the discourse.

The debate addresses the current grid congestion in certain regions of Sweden (short-term challenges) and inevitably also concerns the related question of Sweden's energy future (long-term challenges). The extent to which the vision of the centralized narrative resembles the current system, and how much the solutions it advocates are concerned with preserving the system's current structure, is noteworthy. The centralized narrative also omits to present a distinct energy future since it advocates a system that is very similar to the present system. By contrast, the decentralized narrative contains more distinct future visions since it advocates solutions that have yet to be realized.

I have summarized the core characteristics of the centralized and decentralized narratives in Table 5: a) how the problem of grid congestion is framed, b) the consequences of not dealing with the problem, and c) the way forward. For a more elaborate account, see sections 5.2.2 and 5.2.3. However, before I show how user flexibility fits into these discourses (as well as the system structures), I will briefly explain in section 5.2.1 what centralized and decentralized system structures actually mean.

Table 5
Summary of the centralized and the decentralized narratives (Paper II).

	Centralized narrative	Decentralized narrative
Problem	*1st strand* The decommissioning of nuclear power plants Decrease in power production Loss of control *2nd strand* Neglected national power grid Increasing electrification of society	Outdated electricity system Increasing electrification of society Climate change requires new solutions
Consequence	Impeded economic growth Loss of job opportunities Increased electricity prices Blackouts Impaired energy transition	Unachievable climate goals Impaired energy transition
Solution	*1st strand* Halt the decommissioning of nuclear power plants Remove counterproductive taxes Build next-generation nuclear power plants *2nd strand* Improve national infrastructure and international connections	Decentralization User flexibility Smart grids Renewable energy production Local energy production Multi-level collaboration

5.2.1 Centralized and decentralized electricity systems

Centralized electricity systems are characterized by large production facilities that supply energy to sizeable geographical areas. The electricity is commonly generated at distant locations and transmitted to the user via long transmission lines and large distribution networks (Alanne & Saari, 2006; Bhadoria et al., 2013). The strong coupling among the system units that is a feature of centralized electricity systems results in a very rigid system structure (Quezada et al., 2014). Introducing new technology is complex because changing one unit affects the structure of the entire system (Palm, 2006). However, very large system structures, such as international super grids, could enable more international trade, increase grid connectivity, allocate production to sites with optimal conditions (Schellekens et al., 2010, 2011), and promote global governance (Mayer & Acuto, 2015).

A decentralized electricity system is to some extent the antithesis of a centralized system (Alanne & Saari, 2006). However, this does not imply that the two are

incompatible or that they cannot be combined. In fact, combining the benefits of centralized and decentralized electricity systems has been deemed desirable for addressing the challenges of sustainable energy production and consumption (Alanne & Saari, 2006; Funcke & Bauknecht, 2016). To date, no common definition of a decentralized electricity system exists; however, certain features are associated with a decentralized structure, including the geographical proximity and adjacency of the electricity production and consumption units, and a direct connection between the source of power generation and the distribution grid or the local networks (Ackermann et al., 2001). The independency of units allows for a more flexible system in terms of resilience, adaptation, and reaction to change (Alanne & Saari, 2006; Pepermans et al., 2005). Decentralized electricity systems are also deemed to encompass more democratic forms of electricity production and consumption, such as more equal control over the production and conversion facilities, more influence over the decision-making processes, a reallocation of responsibilities, and more direct ownership (Alanne & Saari, 2006).

For the sake of the analysis, I constructed the narratives by combining the typology of Lönnroth et al. (1978) and the typology of Funcke and Bauknecht (2016) (Table 6). In this typology, a centralized electricity system is dominated by a few large actors, whereas a decentralized electricity system is inhabited by a plethora of actors of varying size. The production facilities of centralized electricity systems are large and few in number, and are operated by specialists, while generalists operate the many small production facilities of decentralized electricity systems (Lönnroth et al., 1978). Maintaining the balance between supply and demand (i.e., the flexibility of the system) is mainly the responsibility of the supply side in centralized electricity systems, in which the flexibility is commonly provided by adapting the output. In decentralized electricity systems, the flexibility may come from both the supply side and the demand side; generated by flexibility options such as small-scale power generation, demand-side management, and small-scale batteries. Thus, the responsibility of maintaining system balance in decentralized electricity systems may be distributed among transmission system operators (TSOs), distribution system operators (DSOs), and consumers (Funcke & Bauknecht, 2016). ‘Centralization’ and ‘decentralization’ may thus refer to both the technological structure of a system and its governance model (Lönnroth et al., 1978).

Table 6
Typology of centralized and decentralized electricity generation.

	Centralized electricity system	Decentralized electricity system
Electricity market	Few large actors	Several smaller actors
Facilities	A few large power plants that require specialists to operate	Several smaller facilities that require generalists to operate
Connectivity	Power plants are connected to the transmission grid and large distribution networks	Power plants are directly connected to the distribution grid or local networks
Proximity	Power plants are commonly situated at distant locations	Power plants are commonly situated in close proximity to the consumption centres
Flexibility	Flexibility is provided by the supply side	Flexibility may be provided by both the supply side and the demand side
Controllability	Maintaining systems balance is the responsibility of centralized TSOs	The responsibility of maintaining system balance may be distributed among TSOs, DSOs, and consumers
Accountability (centralized/local)	Accountability is centralized	Accountability is decentralized and divided between local, regional, and national institutes and actors
Accountability (public/private)	Government and a few large actors	Municipal institutions, neighbourhoods, and local facilities

5.2.2 The centralized narrative

Two strands within the centralized narrative were distinguished by their diverging views on the root cause of grid congestion, which led to different remedies being proposed. The first and most prominent strand argued that grid congestion stemmed from a lack of production. The second and less prominent strand blamed grid congestion on poor infrastructure. What united the strands was their normative view of the electricity system as a centralized entity and their expectations regarding the consequences should grid congestion go unresolved.

To understand the arguments of the first strand, one must recognize the historical role of nuclear power in Sweden's transition into a rich welfare state. Energy-intense industries have long relied on the stable baseload from nuclear power, and so nuclear power has come to represent prosperity, stability, and economic safety (Anshelm, 2000). In times of uncertainty and grid instability, the blame is placed on energy

policies that have jeopardized the longevity of nuclear power. Contemporary energy policies have rendered nuclear power plants and local combined heat and power facilities unprofitable and resulted in their premature decommissioning. The closing of these facilities is interpreted as losing a plannable and controllable baseload, leading to grid congestion.

The solution the first strand of the centralized narrative proposes is thus an increase in electricity generation in general, and in particular an expansion of plannable and controllable production, such as nuclear power. The aim is to regain control over electricity production. Wind and solar power are not deemed adequate replacements for nuclear power and other sources of controllable baseloads. Remedying the grid congestion thus requires economic support of plannable power sources, either by removing unfavourable taxation or by providing subsidies. Other solutions go one step further and propose an expansion of nuclear power production by building small modular reactors.

The second strand of the centralized narrative frames the problem more in terms of a systemic failure to meet growing demand. The decarbonization of society will require the electrification of multiple societal sectors, and the current grid infrastructure is not adapted to make such a shift. The second strand thus considers the grid congestion to be the result of a combination of growing demand and poor maintenance of existing infrastructure. As a solution, it proposes more investments in infrastructure, in combination with more international collaboration.

The centralized narrative warns about the consequences of failing to resolve the current grid congestion, focusing on the economic ramifications of a malfunctioning electricity system. Too little plannable and controllable power production will jeopardize the prosperity of Sweden by hampering the economic engines of the nation – the timber industry, the chemical industry, the mining industry, and the steel industry – resulting in loss of tax revenues, loss of job opportunities, and ultimately stagnation of economic growth. A secondary consequence of the loss of controllable power production will be soaring electricity prices. The grid congestion is said to drive up electricity prices, and introducing more intermittent electricity production into the energy mix is predicted to inflate the prices even further. According to the centralized narrative, the only safeguard against price inflation is a stable system where power production can be controlled. Also present, but less prominent, is the claim that grid congestion will obstruct the transition to a low-carbon economy.

The ways in which the centralized narrative mainly addresses short-term challenges and gives little consideration to long-term issues are noteworthy. No distinct vision of an energy future is presented. Instead, the narrative emphasizes solutions to grid congestion that will maintain the integrity of the current system.

5.2.3 The decentralized narrative

The decentralized narrative builds on ideas of sustainable development and transitioning to a low-carbon economy. In doing so, it emphasizes the importance of decarbonizing electricity production by increasing the share of renewable energy sources and building a more flexible system. It also advocates for multi-level collaborations between the public and private sectors and among local, regional, national, and international actors.

The decentralized narrative regards grid congestion as the symptom of a problem rather than the problem itself. The real problem, according to this narrative, is an outdated system that is ill-equipped for contemporary needs and conditions. The decarbonization of society will require electrification of multiple sectors, and it is this new and vast demand for electricity that is causing grid congestion. However, solving grid congestion is less important than the transformation of the electrical system into a sustainable system.

As a part of the sustainability discourse, the decentralized narrative advocates for building resilience and finding sustainable solutions. It argues that failure to address grid congestion, and ultimately climate change, will impair the energy transition and result in unachieved climate goals. Moving away from fossil fuel dependency will require a decentralized structure and a more flexible system.

The decentralized narrative emphasizes technology and innovation, and its remedies for grid congestion involve technological improvements. The most prominent solution envisages a decentralized electricity system in which energy users are no longer passive consumers but active prosumers. Privately or communally owned solar production units will complement regional wind and hydropower plants.

The decentralized narrative is in favour of a system that relies solely on renewable energy sources. It recognizes that increasing the share of intermittent electricity production, such as wind and solar power, will create new preconditions for electricity consumption. An intermittent system requires user flexibility, that is, users must have the ability to modify their consumption in time, intensity or space to accommodate the availability of electricity. The decentralized narrative thus promotes energy efficiency measures as well as user flexibility to facilitate more even electricity consumption and avoid peak loads.

The narrative's emphasis on user flexibility ties into another of its solutions to grid congestion, namely smart grids, that is, 'the overlaying of a unified communications and control system on the existing power delivery infrastructure to provide the right information to the right entity' (Siddiqui et al., 2008). By integrating information and communication technologies (Koohi-Kamali et al., 2013), smart grids create a system of systems (Camarinha-Matos, 2016). As such smart grids are defined by their functions and abilities rather than with reference to a specific technology (Hashmi et al., 2011). The decentralized narrative promotes the active participation

of electricity users that smart grids will enable, such as user flexibility. By installing smart technology, users will gain control over their usage and thereby become more efficient in their use of electricity.

Lastly, the decentralized narrative extends the idea of decentralization beyond the physical structure of the grid, as it also advocates a decentralized form of governance. Corresponding to the typology of Lönnroth et al. (1978) and Funcke and Bauknecht (2016), energy governance is depicted as a joint process involving municipal institutions, with the help of industries, local facilities, and neighbourhoods.

5.3 Four perspectives from the energy sector on user flexibility

Now that I have examined Swedish media discourse and seen how user flexibility is associated with progressive ideas about technology and sustainability in the media, I turn my attention to the supply-side actors in the energy sector. Energy utilities wield vast societal influence and power, and so constitute powerful change-agents with the means to influence energy transitions (Heffron, 2023; Heffron & McCauley, 2014; Jenkins et al., 2014; Manjon et al., 2021) Thus, it is only reasonable to examine how these actors envision the energy transition and how they perceive the role of user flexibility. The results in this section are from Paper III, in which four perspectives on user flexibility were identified and subsequently synthesized into four archetypes – System Operators, Analysts, Flexibility Advocates, and Entrepreneurs. I present these archetypes in sections 5.3.1–5.3.4 below. In the concluding section (5.3.5), I view the energy utilities' understandings of user flexibility through the lens of the flexibility capital concept to highlight similarities and discrepancies between the two.

5.3.1 System Operators

System Operators express views that mainly correspond to the centralized narrative. The main concern of System Operators is maintaining system balance throughout the energy transition. They believe that the energy transition is best facilitated by using conventional methods and institutions. Thus, they are somewhat sceptical about user flexibility, especially when it comes to remedying large system imbalances. Instead, they regard user flexibility as a minor component of the system and as a tool for supporting the system under very specific circumstances. User flexibility is seen as relevant only to large electricity users, such as industries and businesses, since the contributions of small users and households (even when

aggregated) are insignificant in the situations in which user flexibility will be required.

System Operators regard flexibility capacities as dependent mainly on financial and technical assets. When it comes to the flexibility of industries specifically, they identify the production process as a major enabler. For example, the extent to which an industry can be flexible is determined by the sequencing of the production units, the synchronization of production units, the working hours of the employees, the constitution of supply-chains of subcontractors, and its geographical proximity to suppliers and customers.

System Operators ascribe both economic and technological risks to user flexibility. Other risks pertain to transparency and controllability, since System Operators believe that user flexibility will result in a system that is less transparent to all actors involved and more difficult to control.

5.3.2 Analysts

Analysts express opinions that align with both the centralized and the decentralized narrative. Analysts apply a holistic approach to the energy sector as well as to energy transition, and emphasize the complexity of both. Their main concern is how the benefits and burdens of energy transition should be allocated and are of the opinion that the complexity of the question means that there is no satisfactory answer. They assume that increased participation of users in the production and consumption of energy will amplify complexity even further. User flexibility is perceived as inadequate to address the distribution issues that may arise from the energy transition. Nevertheless, they also believe that user flexibility will be an important component in the transition to a sustainable energy system, albeit not fundamental to its design.

Flexibility capacities are regarded as determined mainly by financial assets, material resources, and user size. Small users, such as households and small businesses, have an advantage in that they are more agile and can more readily respond to signals and adapt. However, their moderate energy consumption means that they can provide only relatively small amounts of user flexibility. Conversely, energy-intense industries and businesses may have a higher degree of potential flexibility, due to their high consumption. However, their large size comes with a certain amount of rigidity and inertia, and responding to unexpected cues may be difficult. Their main advantage is their financial and material assets, which enable them to invest in smart technology.

Analysts do not believe that user flexibility will be disadvantageous to individual users per se, but do see it as posing problems for the entire system. More user involvement creates more factors to take into consideration. The complexity of integrating user flexibility into the system will render it unpredictable, and

remedying imbalances with user flexibility therefore risks creating unexpected ripple effects.

5.3.3 Flexibility Advocates

Flexibility Advocates express views that mainly align with the decentralized narrative. Flexibility Advocates are firm believers in user flexibility and regard it as a fundamental component of a sustainable energy system. They believe that contemporary problems related to electricity production and consumption can all be remedied by more smart technology and cross-sectoral collaborations that facilitate flexibility. Thus, the key to a successful energy transition is forging beneficial collaborations. According to Flexibility Advocates, opening the energy market to more participation is cardinal to a fast energy transition as well as to building trust among actors and creating a democratic and inclusive energy sector.

Increasing users' participation in the production and consumption of energy is regarded as a logical step towards a more sustainable energy system. However, the extent to which user flexibility is integrated will depend on the context. Flexibility Advocates recognize that different users have different capacities to be flexible in their use of energy, but do not consider this to be a major issue. Instead, the main problem will be to identify where the flexibility potentials are located and make use of them in order to maximize the benefits for the system. Since smart technology and collaborations are believed to remedy potential differences in flexibility capacity, the focus of the energy transition should be on a fair allocation of costs and benefits among users. This is regarded as primarily a political endeavour and not as something that should be left to the energy sector to handle.

Flexibility Advocates understand flexibility capacities in terms of three key factors: user size, knowledge, and geographical context. The size of the user influences its flexibility capital in two ways. First, greater consumption is equated with greater scope for flexibility. Secondly, larger users tend to have more assets at their disposal than smaller users, including financial resources, technological resources, and manpower. Knowledge and know-how contribute to user flexibility capital in that they create competencies for responding to signals and economizing. It is the geographical context that ultimately determines the type of flexibility needed, and local conditions will thus influence flexibility capacities.

Flexibility Advocates acknowledge that user flexibility will likely make daily life more complicated for users. However, they regard this as positive since it will result in more environmental awareness. Restrictions in daily life will bring about behavioural changes and habits that are more in accordance with the ecological limits of the planet.

5.3.4 Entrepreneurs

Entrepreneurs express opinions that mainly align with the decentralized narrative. According to Entrepreneurs, user flexibility is an integral component of a sustainable energy system. They have a neoclassical economic perspective on user flexibility, and as such they emphasize investments, profitability, and scalability. They also believe that a sustainable energy transition needs an equal focus on environmental concerns and financial considerations. According to Entrepreneurs, facilitating the energy transition requires a regulatory framework that provides market opportunities and allows for a quick return on investment for more actors. User flexibility and marketization within the energy sector are not only regarded as instruments for and pathways towards a sustainable energy transition, but also as a means of lowering the economic risks, since the more actors involved in the production and consumption of energy, the more units the economic burdens are distributed among.

In theory, any actor with a technological resource can provide user flexibility; however, in the initial phase of the energy transition, the focus should be on large users since this would have the largest effect. Only in later stages when the technology has matured should aggregated flexibility from small users be utilized.

Entrepreneurs identify three main decisive factors related to flexibility capacity: opportunity costs, knowledge, and technological resources. The primary driver of user flexibility is considered to be opportunity costs. In essence, if it is unprofitable for an actor to be flexible in their use of energy, they will not respond to any signals. Conversely, should the economic returns of being flexible exceed the opportunity costs, then the actor will make the transaction. Entrepreneurs acknowledge that opportunity costs are more pertinent to large-size industry actors, since smaller users in general and households in particular tend to be more concerned about comfort and making daily life work. The secondary driver of user flexibility is knowledge. Entrepreneurs believe that the reason only a handful of actors are currently selling their flexibility is a lack of knowledge. If understanding of the economic benefits of user flexibility were more widespread, more actors would understand the value of participating in the flexibility market. Lastly, the tertiary driver of user flexibility is technological resources. Not having the ability to monitor and respond to signals from smart technology is a barrier to user participation.

Entrepreneurs' main concern about user flexibility is that the market might saturate prematurely, which would render new investments unprofitable. Since they regard the market as the sole driver of the energy transition, saturated markets entail stagnation and a barrier to change.

5.3.5 Energy utilities and flexibility capital

Two key variables differentiated the four archetypes, namely their view of the role of user flexibility and their emphasis on the social issues of the energy transition. Figure 4 displays the perspectives of the archetypes according to these variables. The x-axis represents the extent to which user flexibility is believed to be integrated into the design and operation of future energy systems, while the y-axis represents the level of importance given to social issues concerning the distribution of the benefits and burdens related to the energy transition. System Operators and Analysts express doubts about the significance of user flexibility in maintaining system balance, while Flexibility Advocates and Entrepreneurs believe that user flexibility will be integral to supporting future energy systems. The archetypes could also be grouped according to their emphasis on distribution issues. Analysts and Flexibility Advocates highlight how the involvement of users in the production and consumption of energy must also consider the distribution of benefits and burdens. However, neither the Analysts nor the Flexibility Advocates recognize that user flexibility in itself might become a source of unequal and unfair distribution.

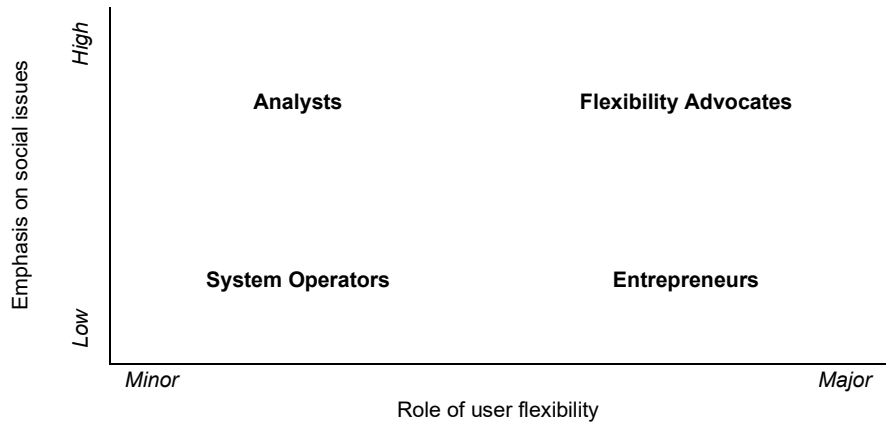


Figure 4
Perspectives of the archetypes on the role of user flexibility and distributional issues.

All four archetypes have limited understanding of the social equity issues of user flexibility to which the flexibility capital concept calls attention. This limited understanding is problematic, since disregarding how user flexibility might be beneficial to some while being disadvantageous to others risks overlooking its energy justice implications. However, the archetypes did recognize the uneven distribution of flexibility capacities among users, even though they did not consider this to be as serious an issue as suggested by the flexibility capital concept (Libertson, 2022a; Powells & Fell, 2019). Financially rewarding users for their flexibility was regarded as something positive for several reasons. System Operators

believe that maintaining system balance will benefit society at large, and if this is achieved through user flexibility, then financially compensating some users for their flexibility is only fair. Analysts deem that there are no easy answers to distribution issues, and that financially rewarding certain users for their flexibility might be a necessary trade-off. Entrepreneurs do not find economically compensating users for their flexibility problematic since it accords with market logic, while Flexibility Advocates deem the redistribution of wealth a political affair and not an issue restricted to the energy sector.

All four archetypes also tend to associate user flexibility with large users, such as industries and businesses. This narrow view of user flexibility is problematic, since overlooking smaller users in general and less affluent users in particular results in limited understanding of how flexible uses of energy may impact daily life. The archetypes also tended to overemphasize certain factors of flexibility capital while being unaware of others. They mainly understood flexibility capital as having access to material and immaterial resources, such as financial assets, technological assets, knowledge, and know-how. Some socio-temporal factors were also mentioned, but only in relation to large users with some form of production line, specific working hours, or a particular geographic location. When it came to households, only material assets were mentioned in relation to flexibility capacity, namely financial resources, technological resources, and knowledge. Yet again, this displays ignorance regarding the extent to which user flexibility might impact the daily lives of users.

5.4 User perceptions of providing flexibility

Having seen how user flexibility is perceived among actors on the supply side of the energy sector, I now turn my attention to the demand side and end users, using a mixed methods case study of so-called smart charging (Paper IV). Using smart charging technologies to charge electric vehicles is a means of providing user flexibility (García-Villalobos et al., 2014). The technology enables end users themselves or an external operator to reallocate their electricity use to time slots when demand is low, or to adapt the intensity of their electricity use to prevent energy peaks and use the available electricity more efficiently (Amoroso & Cappuccino, 2012; Huber et al., 2019). Paper IV investigates how smart charging is understood by electric vehicle drivers and the ways in which their flexibility capital affects their capacity to be flexible. In this regard, the study provides an insight into how flexible uses of electricity and user flexibility are understood by end users.

The study yielded two data sets, one qualitative and the other quantitative. Section 5.4.1 outlines the results of the qualitative data, and section 5.4.2 describes the correlations found in the quantitative data. In section 5.4.3 the data sets are

compared through the lens of flexibility capital in order to determine whether they converge or diverge.

5.4.1 Interviews on providing flexibility

5.4.1.1 Functional attributes

Functional attributes relate to the perceptions of what smart charging and user flexibility do for the individual user (Axsen et al., 2017). Participation in smart charging schemes was understood as a more efficient use of electricity that would lower the energy costs of the household or even create additional revenue streams. However, it was also understood as an entirely new way of consuming electricity that would entail a change in behaviour and a change of routines for the user, such as more elaborate planning before and during trips. This, in turn, was seen as restricting the freedom of the user and causing a loss of control. Several respondents doubted the ability of smart charging to accommodate their mobility needs. This uncertainty stemmed from the perceived insufficiency of contemporary technology, including poor and unreliable infrastructure and the limited range of electric vehicles.

The respondents viewed the functionality of smart charging as dependent on their financial resources. They believed that in order to participate fully in smart charging schemes without compromising their own comfort, expensive investments in technology were necessary, such as electric vehicles with large battery capacities and private charging stations. The respondents were also concerned about their own compatibility with smart charging, that is, whether they would be able to make all the necessary rearrangements in their daily lives. User flexibility was to some extent perceived as something beyond the control of the user due to limiting factors such as work hours, other household members, the type of accommodation, access to charging stations, and the type of electric vehicle.

5.4.1.2 Societal attributes

Societal attributes are perceptions of what smart charging and user flexibility do for society (Axsen et al., 2017). A common understanding was that by being more flexible in their use of energy, they would contribute to a more flexible system. This, in turn, was considered positive, since the respondents believed that a more flexible system would more efficiently guarantee the energy supply. A more flexible system was also understood as more able to accommodate intermittent and renewable electricity production. Thus, by being more flexible in their use of electricity, the respondents believed that they could facilitate the integration of renewable energies and ultimately a transition to a sustainable energy system. Lastly, flexible uses of electricity were also deemed to remedy infrastructural problems such as grid

congestion and transmission bottlenecks. These perceptions correspond to a large extent with the decentralized narrative.

5.4.1.3 Symbolic attributes

Symbolic attributes refer to the perception of the messages that smart charging and user flexibility convey (Axsen et al., 2017). Three themes stood out during the interviews, namely altruism, technological advances, and new market forms. The respondents deemed electricity a societal and collective resource that should be governed accordingly. Providing user flexibility via smart charging schemes was viewed as contributing to society, and even as an act of altruism. By providing flexibility to the electricity system, users perform an act of service for the greater good, according to some respondents. Other respondents considered smart charging a natural development of the electricity system in line with other technological developments. For these respondents, smart charging symbolized a new market form in which users are incentivized to become more active by being offered economic compensation in exchange for providing system benefits. These respondents viewed smart charging and user flexibility primarily as a potential new revenue stream for the household. Other respondents viewed smart charging and user flexibility as an opportunity to contribute to society and as a new market. They believed that by participating in this new market, users could have a positive influence on society.

5.4.2 Survey on providing flexibility

Several interesting correlations between the needs, wants, and resources of the respondents and their readiness to provide user flexibility were identified in the survey. The survey investigated users' readiness to provide flexibility in terms of their willingness to participate in smart charging schemes. This willingness was quantified in terms of the amount of time for which the respondents would accept smart charging during a charging process. The flexibility capital factors that were investigated concerned material assets, technological resources, knowledge, and a mix of socio-temporal factors.

Material assets and technological resources were investigated in terms of being guaranteed access to charging stations and the type of electric vehicle. Strikingly, having guaranteed access to a charging station did not seem to influence the respondents' readiness to provide user flexibility. Regardless of the time of day, there was no correlation between guaranteed access to a charging station and the amount of time that the respondents would accept smart charging during charging. However, dependence on public charging infrastructure did seem to influence the readiness of electric vehicle drivers to provide flexibility (more on this below). The respondents could indicate whether they drove a hybrid-electric vehicle (powered by both an electric engine and a combustion engine) or a fully-electric vehicle

(powered by an electric engine only). Respondents driving a hybrid-electric vehicle displayed statistically significantly higher readiness to participate in smart charging compared to respondents driving a fully-electric vehicle. In summary, material assets and technological resources appear to have some significance for the flexibility capital of the user, in that the type of electric vehicle was shown to influence the willingness to provide user flexibility although the type of access to a charging station did not.

Knowledge and experience were defined in this study as the number of years for which the participant had been driving an electric vehicle. No correlation was found between the number of years driving an electric vehicle and the readiness of the respondents to participate in smart charging. Thus, the survey could not demonstrate that knowledge affects the flexibility capital of the user.

Socio-temporal factors were investigated in terms of public infrastructure, norms, and conventions, that is, the amount of charging and distance that the respondents deemed they needed to travel in order to meet their daily needs for transport. Dependence on public infrastructure for charging was observed to be statistically significant for the respondents' readiness to provide user flexibility. The higher the perceived dependence on public infrastructure, the lower the amount of time the respondents were willing to accept smart charging during a charging process. Several tests also confirmed the correlation between the perceived need for electricity and the readiness to provide user flexibility. For example, respondents who indicated that they wanted fast and full charging during charging sessions accepted less smart charging time during charging. Similarly, respondents who tended to charge more kWh per charging session were less willing to participate in smart charging over longer time periods. Lastly, the daily needs for transport, here understood as average mileage per month, was not reflected in the readiness of the respondents to provide user flexibility. No correlation was found between miles driven per month and the amount of time the respondents would accept smart charging during a charging process. In sum, several socio-temporal factors were observed to influence the flexibility capital of the user, in that more dependence on public infrastructure and greater needs for transportation lowered the respondents' readiness to provide user flexibility.

5.4.3 User flexibility capital

The framework of flexibility capital was used when comparing the results from the qualitative and quantitative data sets. Once again, the flexibility capital factors that constituted the analysis were material assets, technological resources, knowledge, and a mix of socio-temporal factors. ***Financial assets*** were not specifically investigated in the interviews and the survey. However, it is worth noting that insufficient charging during a smart charging process resulted in one respondent renting a car. This example shows how financial assets provide more opportunities

for maintaining flexibility. By paying a temporary fee, users can provide both user flexibility and maintain their own mobility and flexibility, and thereby also avoid rearranging their daily schedules.

In terms of ***material assets and technological resources***, the interview respondents deemed that their capacity to provide user flexibility via smart charging depended on the type of electric vehicle and charging technology. Having an electric vehicle with a larger battery and a private charging station at home were regarded as increasing flexibility capacity. These findings from the interviews converge to some extent with the findings of the survey in that the type of electric vehicle was found to influence readiness to provide user flexibility, but guaranteed access to a charging station was not. Thus, the qualitative and the quantitative data only partly converge in relation to material assets and technological resources.

In the analysis of the interview, the study defined ***knowledge*** as users' awareness, familiarity with, and grasp of the implications of smart charging (Axsen et al., 2017). The interviews showed that although somewhat unfamiliar with the terminology, the respondents were aware of the general principles involved. None of them had previous experience with externally managed smart charging on an aggregated level, but a few had optimized their charging at home in response to price variations. In general, the interview respondents had a good understanding of the implications of user flexibility, both on a personal level and on a system level. User flexibility was understood as a means of contributing to a more balanced electricity system, which could accommodate more renewable electricity production. User flexibility was also understood as a new market that could potentially provide additional revenue streams to the household.

On a systems level, the interview respondents understood the value of a more controlled form of electricity consumption and the positive impact it would have for society. However, on a personal level, several voiced concerns about how user flexibility would affect their personal lives. Several doubted that they would be able to participate in smart charging schemes due to the perceived inflexibility of their daily lives. Thus, knowledge about user flexibility did not necessarily translate into higher capacity to be flexible, despite strong motivational factors such as environmental concerns and grid stability. This same ambiguity was evident in the survey responses, which showed that knowledge, there defined as the number of years of experience of driving an electric vehicle, did not translate into higher readiness to provide user flexibility. In this regard, the qualitative and the quantitative data converged.

Lastly, the qualitative and the quantitative data also converged in terms of ***socio-temporal factors***. Both the interviews and the survey confirmed that dependence on public infrastructure influences users' readiness to provide flexibility – the higher the dependence, the lower the readiness. The data from the interviews also suggested that accessibility and proximity to public infrastructure are factors that influence

user flexibility. The survey explored the extent to which respondents valued fast and full charging, and showed that the more the respondents valued it, the lower their willingness to be flexible. Conversely, charging fewer kWh per charging session resulted in greater readiness to provide user flexibility; an indication that a small everyday need for charging provides more scope for user flexibility. Another way of interpreting this finding is that inflexible lives result in hesitancy about user flexibility, which can require extensive rearrangement of daily activities. This finding is supported by the interviews, which showed that the respondents compensated for inflexibility by elaborate planning before and during trips, which was a source of stress and anxiety.

6.

Spirits were high in the room. Every associate of Rooster Consultancy Inc. was assembled and waiting for Mr. Smith and Mr. Smyth to make their announcement. The new owners had called to a meeting and nothing less than revolutionary ideas were expected.

"Esteemed entrepreneurs," Mr. Smith began. "We are happy to announce…"

"We announce happily…," interposed Mr. Smyth.

"A new pricing model!" said Mr Smith and Mr Smyth jointly.

"Starting from next week, your fees will be based on dynamic pricing," said Mr Smith.

"Dynamic pricing will form the basis of your fees from next week," said Mr. Smyth.

"This means that your payments will be adjusted in accordance with demand," said Mr. Smith.

"To better align supply and demand," interjected Mr. Smyth.

"If you have any questions about how this will affect your salary, please contact HR," said Mr. Smith.

"Please contact HR with any and all questions about how this will affect your salary," said Mr. Smyth.

The late hours had made Bartleby weary. His absent-mindedness and constant yawning exhausted Mrs. Bartleby's patience, and she eventually ushered him to see the doctor.

"Mr. Bartleby, you are overworked and sleep-deprived," concluded Dr. Goodfellow.

"No-no, that cannot be it," said Bartleby; his self-image blemished.

"I am afraid so," assured Dr. Goodfellow. "I strongly recommend you stop working nightshifts."

"But demand is highest during nights," argued Bartleby. "Some of my best clients are based in Asia."

"That cannot be helped," said Dr. Goodfellow. "As your doctor, I recommend you get some proper sleep."

Relieved that his weariness appeared to have a natural cause, Bartleby could not help but think of all the lost revenue that working dayshifts would entail.

6 The two stories of user flexibility

In the previous chapter, I presented three perspectives on user flexibility, namely, the perspectives of public news media, industry experts, and end users. These perspectives were to varying degrees either optimistic or hesitant about user flexibility as a feature of future electricity systems. In the public media discourse, user flexibility was associated with the decarbonization agenda, that is, with progressive ideas about decentralized electricity systems, renewable electricity production, and sustainability in general. Industry experts generally framed user flexibility as something positive, but disagreed on the extent to which it will be used and its effectiveness. End users expressed positive attitudes towards user flexibility as a concept but were concerned about how it would affect their daily lives. It is notable that the arguments for flexibility seen in the public discourse were replicated by industry experts and end users, suggesting a positive feedback loop of influence.

In my opinion, discussing research findings implies taking a step back to reflect on their implications in a broader context. In doing so, the researcher pulls the findings together to help readers interpret their implications and see the 'red thread' throughout the work. When considering my four years' of research from a distance, what I see is two stories about user flexibility – the one a comedy and the other a tragedy. A comedy is a story about rising fortune, whereas a tragedy is a story about downfall (Morreall, 2016). 'User flexibility, the comedy' depicts user flexibility as a way to successfully decarbonize society and increase energy justice. 'User flexibility, the tragedy' regards user flexibility as likely to decrease energy justice.

In section 6.1, I present the optimistic view of user flexibility as contributing to engineering a sustainable electricity system. I also relate these views to previous research, showing how they fall within a long tradition of techno-optimist thinking reflected in the dominance of technological and economic reasoning in public discourse. In section 6.2, I present the pessimistic view of user flexibility by relating my findings to previous research on flexibility capital and energy justice. In doing so, I postulate the inadequacy of financial incentives to facilitate user flexibility. Finally, in section 6.3 I discuss ways to minimize the energy injustices of user flexibility. I argue that the potential energy injustices of user flexibility are linked to market-based principles, and that exploring alternatives

for incentivizing flexibility, such as non-financial incentives (Anda & Temmen, 2014), could potentially reconcile user flexibility and energy justice.

6.1 User flexibility, the comedy

In the opening section of Chapter 1, I listed a number of arguments that proponents of user flexibility use to justify its implementation. In addition to arguments about how user flexibility will aid the decarbonization of electricity production and consumption (Wright, 2018), I also gave an account of the economic (Bradley et al., 2013), systemic (Lund et al., 2015), and environmental arguments (Martínez Ceseña & Mancarella, 2018) in favour of user flexibility, all of which were echoed in the results in Papers II–IV.

My analysis of the media discourse (Paper II), and of the responses of industry experts (Paper III) and end users (Paper IV) showed that all presented arguments for user flexibility relating to decarbonization strategies. The decentralized narrative revealed the associations between user flexibility and the integration of renewable energy production. More concretely, user flexibility was viewed as a tool for realizing the decarbonizing potential of decentralized systems, namely increasing the proportion of electricity from renewable energy sources. The extent to which user flexibility would be integrated into the design of the electricity system divided industry experts; however, many believed that a sustainable electricity system would require user flexibility. When asked about the societal benefits of user flexibility, the end users spoke of the integration of renewable energy production. They believed that by providing flexibility, they would accommodate the process of making greater use of renewable energy. Taken together, these results provide additional evidence of how user flexibility is understood as integral to the decarbonization agenda (Blue et al., 2020).

As regards the economic arguments for more user flexibility found in academic literature (Bradley et al., 2013), my results show that these were also present in the public media discourse and in the responses of industry experts and end users. In the decentralized narrative, user flexibility was presented as an economical option for building new infrastructure. Industry experts, in particular those adhering to the archetype of the Entrepreneur, emphasized the economic potential of greater user flexibility. According to these experts, creating economic incentives for flexibility is the optimal method of facilitating the energy transition. Similar notions prevailed among end users. Respondents understood user flexibility as an economic opportunity, and thought that participating in user flexibility schemes might provide additional income to the household, thus making smart technology a profitable investment. Together, these results provide

further evidence of how energy systems tend to be primarily conceived of in economic terms (Ingeborgrud et al., 2020).

The findings in Papers II–IV provide additional evidence for how greater user flexibility is justified by systemic arguments (Lund et al., 2015). The decentralized narrative depicts user flexibility as a tool for facilitating more efficient use of existing infrastructure. By installing smart technology, users will gain control over their usage and thereby become more efficient in their overall use of electricity. This opinion was also found among industry experts and end users. Several respondents related user flexibility to infrastructure limitations, such as grid congestion. They asserted that transmission constraints can be overcome by making consumption more efficient through user flexibility. The decentralized narrative also asserted that more flexibility will make the electricity system more resilient and better able to withstand unexpected events. Taken together, these findings show that the technical performance of user flexibility is emphasized by its proponents (Blue et al., 2020).

In addition to the above rationales, the results in Papers II–IV contained social arguments in favour of user flexibility. Narrative analysis showed that decentralized systems, and by extension user flexibility, are associated with more democratic processes. Industry experts asserted that user flexibility would require cross-sectoral collaboration, which would increase trust between actors and create a more inclusive energy sector. They believed that allowing users to participate in the operation of the system would increase representation while also raising awareness, since giving users more responsibilities might foster better (and more sustainable) practices in relation to electricity consumption. Thus, in line with previous research (Alanne & Saari, 2006), user flexibility was also associated with higher user engagement and more democratic forms of governance.

The results of Papers II–IV reveal an interesting overlap between the public media discourse and the opinions of industry experts and end users. The sentiments of the decentralized narrative regarding the benefits of user flexibility corresponded to a large extent with the views expressed by both industry experts and end users. The occurrence of these sentiments among individuals and in public discourse may indicate a reinforcing feedback loop, that is, it may indicate that personal opinions influence public discourse and vice versa. The opinions of certain individuals are broadcasted by media, and then picked up by other individuals who disseminate them further in a reinforcing cycle. Overall, this cycle of opinions contributes to creating an imaginary of how user flexibility will bring a happy end to the story of how society became decarbonized (Ballo, 2015; Jasanoff & Kim, 2009). The nature of the arguments is also worth noting. It is evident that the arguments put forward in Papers III–IV appeal to technological and economic thinking. At the core, they constitute arguments for the increased performance and efficiency of the electrical system. As previously mentioned,

this narrow focus on development and implementation has been critiqued in previous research (Blue et al., 2020; Ingeborgrud et al., 2020; Sovacool et al., 2016). Thus, the findings of Papers II–IV also constitute further evidence of the dominance of this type of thinking.

6.2 User flexibility, the tragedy

Before proceeding, I would like to address the claims made in the previous section, where it was shown that user flexibility is perceived as a solution to both grid congestion and environmental issues. This relationship is not unique to my findings and previous research has observed how user flexibility is associated with the decarbonization agenda (Blue et al., 2020). Despite these associations, there is no significant empirical evidence to support the claim that user flexibility will be beneficial for sustainability (Calver & Simcock, 2021). As I argued in Paper I and as several scholars have argued before me (Calver & Simcock, 2021; Smale et al., 2017; Sovacool et al., 2016), solutions such as user flexibility that seek to contribute to the energy transition should not be evaluated solely on their technical and economic performance but also in terms of their fairness and how well they contribute to energy justice. In this section, I demonstrate the connection between the flexibility capital concept and the energy justice framework by discussing the energy justice implications of my findings. More specifically, I focus on user flexibility based on market principles and highlight the potential side-effects of following market logics.

The way in which the facilitation of user flexibility tends to be imagined is through the use of market mechanisms (D'hulst et al., 2015). In this scenario, the end user receives price signals that indicate when it is a good time to use electricity and when use should be limited. On the basis of these signals, consumption may be altered, either manually by the users or automatically by smart technology. Alternatively, consumption may be entirely controlled by an external operator (Smale et al., 2017). Regardless of the approach, the user is financially rewarded for their flexibility (D'hulst et al., 2015). However, given that certain barriers to flexibility relate to socio-temporal structures, relying solely on economic incentives to facilitate user flexibility may prove ineffective (Blue et al., 2020; Jalas & Numminen, 2022). Providing flexibility is not only a matter of economic considerations, but it is also subject to a number of decisive factors (Grunewald & Diakonova, 2018). In this thesis, these factors are conceptualized as a form of capital (Libertson, 2022a; Powells & Fell, 2019), and the capacity of users to provide flexibility is equal to their amount of flexibility capital.

The evidence from my results shows what this means in practice. For example, experts within the energy sector acknowledged that the capacity of industries to be flexible depends on their business model, that is, the sequencing and synchronization of their production units, the working hours of their labourers, their supply chain of subcontractors, and their geographical proximity to suppliers and customers (Paper III). In addition to these financial and material assets, the industry experts also acknowledged that user flexibility is determined by the size of the user, the context in which the user operates, and their skills and knowledge. All of these examples constitute the user's flexibility capital, on which financial incentives will likely have little effect. Another example of how economic incentives may be irrelevant for facilitating user flexibility is the hesitancy of end users to engage in user flexibility schemes (Paper IV). End users perceived providing user flexibility as partly outside their control. In other words, they recognized the limits of their flexibility capital, for they believed that their lifestyles were to some extent incompatible with being flexible. Factors of daily life such as their work hours, dependence on other household members, and type of accommodation were perceived as limiting their flexibility.

The factors industry experts and end users identified as either enabling or limiting user flexibility correspond to the resource and socio-temporal factors in the flexibility capital concept (Libertson, 2022a; Powells & Fell, 2019). These findings suggest the inadequacy of economic incentives when it comes to facilitating user flexibility. The flexibility capital concept problematizes the neoclassical idea that providing flexibility is merely a matter of economic rationality and knowledge. Rather, knowledge is but one of the many factors related to providing flexibility, and the willingness and ability of users to do so rests on more than merely financial consideration. Consequently, knowingly or unknowingly, both industry experts and end users challenge the notion of using economic incentives to facilitate user flexibility. Figure 5 provides a generalized representation of how economic incentives will only be effective in encouraging a quarter of all users to be flexible. It is thus fair to say that relying only on the economic rationality and knowledge of the user to enable flexibility may turn out to be a logical error.

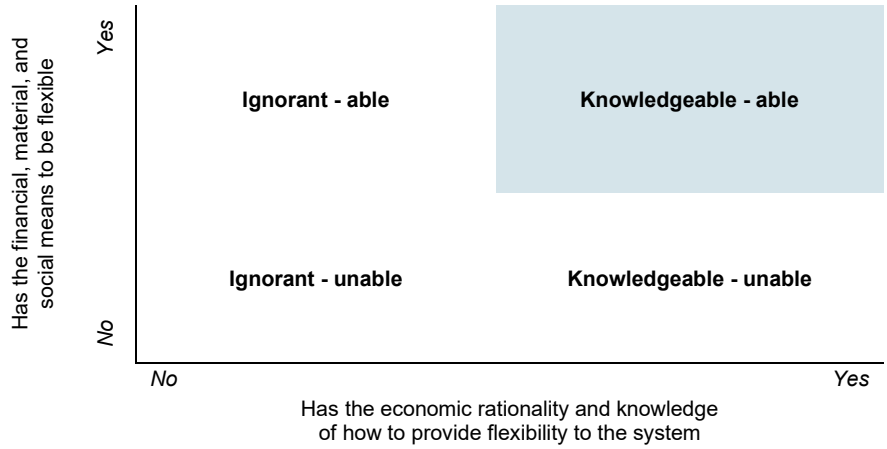


Figure 5
Generalized representation of how providing user flexibility is more than a matter of economic rationality. Economic incentives are shown to be effective for only a quarter of all users. Designing an electricity system that accommodates only one in four users may have energy justice implications.

Yet, an ineffective system is the least of the problems of user flexibility based on market principles. As the flexibility capital concept suggests, the implications of integrating market mechanisms in the operation of the electricity system are more far-reaching than a matter of inefficiency. Figure 5 not only indicates that economic incentives will be effective for only a quarter of users, it also demonstrates that user flexibility schemes are being designed with the ability and interests of only a quarter of users in mind. Engineering a system that only accounts for and accommodates the interests and abilities of users with moderately high amounts of flexibility capital will inevitably have equity implications. In fact, these are the very inequity implications that the energy justice framework highlights. As stated in Chapter 2, energy justice seeks to identify and propose solutions to reduce the social inequalities of energy supply (Jenkins, McCauley, et al., 2016; Sovacool & Dworkin, 2015). Drawing on the three principles of distributive justice, recognition justice, and procedural justice, the energy justice framework analyses how the benefits and burdens of energy systems are distributed across society, identifies the beneficiaries and the disadvantaged, and proposes procedural processes that promote fairer outcomes (Jenkins, McCauley, et al., 2016). Below, I apply these three principles as I proceed to discuss the inequity risks of user flexibility schemes based on market mechanisms.

Distributive justice refers to the way the energy system distributes benefits and burdens. Looking at distributional issues through the lens of the flexibility capital concept, it is reasonable to assume that user flexibility schemes in combination

with market mechanisms will redistribute wealth unequally in a manner that privileges the already privileged. As mentioned previously, some envision using economic incentives to facilitate user flexibility schemes (D'hulst et al., 2015). This type of thinking commodifies users and their behaviours (Ballo, 2015; Libertson, 2022a). A setup based on market mechanisms will financially reward certain types of behaviours, that is, the system will encourage certain conduct by making it a commodity that a user can sell to the system. However, the flexibility capital concept demonstrates that the ability to be flexible is influenced by socio-temporal factors, meaning that some users will have more opportunities to sell their flexibility than others based on the nature of their daily lives – a point raised by several end users in Paper IV. The importance of everyday life when it comes to economizing flexibility has been highlighted in previous research (e.g. Friis & Christensen, 2016; Higginson et al., 2014; Jalas & Numminen, 2022). Furthermore, the flexibility capital concept also shows that being flexible is a matter of owning or having access to resources. The concept thus establishes a link between affluence and the capacity to be flexible; a link that has been confirmed by previous research (e.g. Caballero & Ploner, 2022; von Platten, 2022a; Winther & Sundet, 2023). Basically, the more resources a user has, the more flexibility capital they have, and the higher their ability to provide flexibility; thereby demonstrating how flexibility is a matter of socioeconomic status. Therefore, an electricity system that rewards flexibility based on market principles would amount to a system that rewards wealth. It would become a system primarily for the affluent, one that privileges those already well-off, a sentiment echoed by Adamas et al. (2021). This is the first energy justice implication of user flexibility.

Examining distributive justice through the lens of the flexibility capital concept also highlights equity implications in regard to economic responsibility. From this perspective, it is reasonable to assume that user flexibility will redistribute economic responsibilities in a way that will mainly benefit supply-side actors The aim of user flexibility is to maintain system balance by incentivizing users to become more active consumers. By reallocating the time of consumption, they contribute to balancing demand and supply. However, as the flexibility capital concept suggests, such involvement encourages the users to own smart appliances. In essence, user flexibility means that the system infrastructure becomes dependent on private investments in smart technology such as small-scale batteries, solar panels, and electric vehicles. Thus, user flexibility entails a transfer of economic responsibility, for the economic responsibility of current system operators will partly be distributed among the users able to provide flexibility. Transferring economic responsibility means that costs and risks are also transferred to users. This type of reliance on private capital and economic self-interest to secure future investments has a long tradition in the liberalizing of the energy sector and neoliberal thinking in society at large (Högselius & Kaijser, 2007, 2010). This trend has already redistributed certain costs and

responsibilities from the public sector to the private sector (Sadowski & Levenda, 2020). Figure 6 illustrates how user flexibility might cause a 'trickle down' of costs and responsibilities and how this shift might occur: from the public sector to the private sector and then to individuals. This point parallels the observation by Fjellså, Ryghaug, et al. (2021) that attempts to remove lock-ins from energy systems with user flexibility will only shift the lock-ins from the system to the user. From an energy justice perspective, the attempt to shift the costs of the supply side onto users is unethical. As long as supply-side actors are officially responsible for maintaining system balance and transmission, they should bear their own costs. This transfer of economic responsibility to individuals is the second energy justice implication of user flexibility.

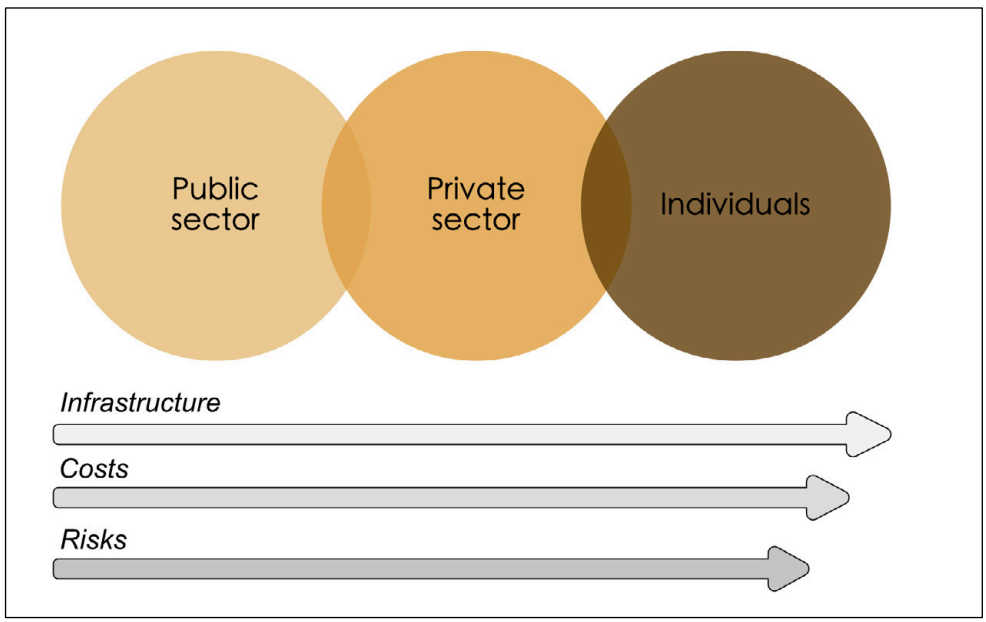


Figure 6
The 'trickle down' of economic responsibilities, costs, and risk from the public sector to the private sector and then to individuals.

Moving on to recognition justice and the implications of unequal participation and differences in benefits: As the flexibility capital concept suggests, the capacity to be flexible is determined by resources and socio-temporal factors (Libertson, 2022a; Powells & Fell, 2019). These factors relate to the socioeconomic structures of society, and are thus to some extent outside the control of users (Jalas & Numminen, 2022; Powells et al., 2014; Walker, 2014). This, in turn, implies that different users will have different opportunities and possibilities to participate in user flexibility schemes based on market mechanisms. As demonstrated by previous research, affluent users with access to

more resources and with more flexible lifestyles will have more opportunities to provide flexibility than their inflexible and less affluent fellows (e.g. Caballero & Ploner, 2022; Fjellså, Ryghaug, et al., 2021; Ribó-Pérez et al., 2021). In other words, user flexibility schemes based on market principles imply that users will be participating on unequal terms. Users with more flexibility capital will have more possibilities to participate and will thus benefit more than users with less flexibility capital. Participation on unequal terms is the third energy justice implication of user flexibility.

Uncertainties about equal participation tie into questions about the purpose of the electricity system. Converting it into a domain of financial opportunities by introducing user flexibility schemes based on market principles prompts questions about the focus of the system and the interests that it serves. For example, would the main objective still be to transmit affordable electricity securely and sustainably, or would the amplification of market mechanisms in the energy sector distort the focus? Take the example of the 1996 deregulation: When energy utilities were collectively owned, the focus was on generating and supplying cheap electricity. However, once privatized, their main objective changed to generating profit for their shareholders, and any other objective was rendered secondary (Högselius & Kaijser, 2007, 2010). The flexibility capital concept implies that a similar shift might accompany greater user flexibility. Using market forces to encourage more user flexibility and facilitate the energy transition was deemed desirable by several industry experts in Paper III. However, when the electricity system becomes a market for buying and selling flexibility, there is a risk that its focus will change from maintaining system balance to making a profit. Indeed, examples from the energy sector show how companies are already developing new business models around user flexibility (Helms et al., 2016). Should the focus shift, the system will serve the interests of users with more flexibility capital better than those with less. The differences in opportunities will mean that more affluent users will benefit more due to their more advantageous preconditions for economizing their flexibility, and thus the system will serve their economic interests more than the interests of other users.

I would like to further emphasize the issues of system purpose and function by linking them to the ideas of Adams et al. (2021) and Fanning et al. (2020). Adams et al. (2021) propose that flexibility should be considered a societal resource and user flexibility a form of extraction. Rather than imagining user flexibility as something that users give to the system, Adams et al. (2021) propose that it is the system that extracts flexibility from the users to remain operational. This perspective on user flexibility as an extracted resource ties neatly into the thinking of Fanning et al. (2020) and contributes to understanding the purpose of a system. As Fanning et al. (2020) indicate, the purpose of a system can be determined by examining the needs that the system satisfies. Provisioning systems are systems that convert resources into goods and services that are

distributed equally to meet societal needs. By contrast, appropriating systems serve only those in control by converting resources into economic rewards that satisfy their individual needs. Since the electricity system does provide societal benefits, this conceptualization of provisioning systems vis-à-vis appropriating systems is not fully applicable. However, it suggests that actors with strategic assets have more to gain economically than actors without. Or, as Calver and Simcock (2021) put it: Even if users with less flexibility capital would be able to participate in user flexibility programmes, there is contradictory evidence whether this group of users will benefit economically. The implication that more affluent users will benefit more from user flexibility is the fourth energy justice implication of user flexibility.

An electricity system that with the help of market-based user flexibility rewards wealth, avoids economic responsibilities, causes users to participate on unequal terms, and benefits different users differently is far removed from energy justice. Energy justice aims to advance energy democracy, alleviate energy insecurity, reduce energy burdens, and alleviate energy poverty (Baker et al., 2019). This brings me to the governance of electricity systems and the potential implications of user flexibility for procedural justice. As mentioned above, user flexibility implies increased involvement by users. However increased participation may come with increased complexity. Building an electricity system that relies on the flexibility of its users to remain operational will likely yield a more complex system, as mentioned by several of the industry experts in Paper III. On the one hand, greater user involvement could result in a more democratic system (Alanne & Saari, 2006). Industry experts of the Flexibility Advocate archetype argue that involving users in the operation of electricity systems will build trust and create a more inclusive energy sector in which users have more ownership and agency. On the other hand, higher involvement by users may also make for a less controllable and transparent system. Industry experts of the System Operator and Analyst archetypes considered that integrating user flexibility would make the system more complex. The Analyst estimated that more user involvement would require more factors to account for and a more unpredictable system, whereas the System Operator judged that involving more actors in the operation of the system would come at the expense of the transparency of the system's governance structures. The users involved would likely understand their part and their role in the system, but the plethora of actors could potentially preclude a general understanding of where one's own responsibility ends and another's begins. For non-involved users, the system might seem even more difficult to comprehend and to navigate than before. For example, previous research has shown that having little or no knowledge can disincentivize participation in user flexibility schemes (Fjellså, Silvast, et al., 2021; Winther & Sundet, 2023).

However, even if for the sake of the argument we assume that involving users will give them more agency in the governance of electricity systems, the concept

of flexibility capital still implies that market-based user flexibility will have procedural implications. Previous research has shown how differences in capacities, abilities, and resources among users may lead to procedural injustices (Calver & Simcock, 2021). As aforementioned, the uneven distribution of flexibility capital among users implies that more affluent users will have more opportunities to participate than their less affluent counterparts. Hence, user flexibility based on market principles will mean that agency will mainly be lent to users with more flexibility capital, while potentially excluding users with little flexibility capital. The overall result may be a less democratic system due to the unfair inclusion criteria based on wealth and lifestyles.

In conclusion, following the logic of the flexibility capital concept, user flexibility based on market principles may potentially contribute to a system that rewards wealth, redistributes economic responsibilities, creates participation on unequal terms, benefits affluent users more than others, increases complexity (in particular for non-involved users), and promotes unfair forms of governance, which ultimately will culminate in less energy justice. The question that then remains is whether these potential negative effects of market-based user flexibility can be avoided. The key term here is 'market-based'. In the next section, I discuss potential alternatives to market-based user flexibility.

6.3 Reconciling user flexibility and energy justice

Just user flexibility requires fair distribution of financial profits and costs, and equal burden sharing (Milchram et al., 2020). Analysing user flexibility from the perspective of flexibility capital reveals that a market-based approach has energy justice implications that render the overall system more unjust. However, as mentioned in Chapter 3, applying the flexibility capital concept as a theoretical framework involves making certain assumptions about the relationship between individual capacities and societal structures. Thus, the energy justice implications of user flexibility are based on specific assumptions and are not predetermined outcomes. Yet, I believe it is necessary to propose some solutions to how these potential energy justice risks could be mitigated. These remedies involve the use of non-financial incentives to facilitate user flexibility in combination with policies and market regulations that aim to minimize energy injustices.

First, user flexibility could be used as a strategy and a political tool to target energy injustices and social inequity. Research has shown that policies aimed at rectifying social inequalities can lead to successful implementation of local user flexibility programmes in low-income areas. Stewart (2023) demonstrates how government backing and support from project partners can localize energy and realize value for communities that would otherwise have been excluded from

such initiatives. Not only did the projects include socially disadvantaged communities in the energy transition, they also generated economic value for them (Stewart, 2023). Savelli and Morstyn (2023) show that certain regions would benefit more than others by integrating more user flexibility. Geospatial analysis can identify areas containing both high-value flexibility and social deprivation. Policies could then target social deprivation while also integrating more user flexibility by deploying user flexibility programmes in areas with low-income users. Savelli and Morstyn (2023) propose that policies should also limit the extent to which affluent users enjoy the economic benefits of user flexibility in order not to contribute to escalating wealth gaps. Setting a cap on economic benefits would target the energy injustice risks of an unfair redistribution of wealth that would mainly benefit the already affluent. These examples show that if cap policies were implemented in combination with government-supported user flexibility programmes in low-income areas, the energy injustice risks of unfair distribution of economic responsibilities, unequal terms of participation, and non-inclusive procedures could be avoided. Thus, governments should more actively focus on including socioeconomically disadvantaged areas in user flexibility programmes and on correcting potential market failures, rather than relying mainly on private investments made in more affluent areas.

Secondly, industry actors and regulators should do more to explore options other than purely economic incentives for flexibility. For example, recent studies indicate the strength of intrinsic motivation for providing user flexibility (Bartusch et al., 2024; Pratt & Erickson, 2020). Bartusch and colleagues (2024) found that while financial incentives raise awareness about the role of user flexibility in balancing supply and demand, these incentives have little effect on current behaviours. Furthermore, they found that the main motivational drivers of the respondents were to reduce their environmental impact, mitigate climate change, and contribute to sustainable development. Thus, they conclude that incentives that appeal to altruistic motives deserve more attention (Bartusch et al., 2024). The findings of Pratt and Erickson (2020) support the idea that pro-social incentive structures are effective in facilitating user flexibility. Using non-financial incentives in user flexibility programmes would avoid exacerbating unfair redistributions of wealth that would benefit affluent users, thereby sidestepping energy injustice risks.

Thirdly, the literature emphasizes that one-size-fits-all designs of user flexibility schemes are detrimental to vulnerable users (Fell, 2019; Ribó-Pérez et al., 2021; White & Sintov, 2019). For example, White and Sintov (2019) found that the electricity bills of households with elderly and disabled people increased disproportionately compared to those of other households when participating in user flexibility schemes. This was probably a result of the inability of these households to time-shift their loads, as they are homebound and dependent on electronic equipment to perform daily tasks. The findings also showed that low-

income households reported adverse health and comfort outcomes when providing user flexibility. White and Sintov (2019) concluded that the design and implementation of user flexibility schemes must carefully consider vulnerable users in order to avoid exacerbating existing social inequalities, a sentiment echoed by Fell (2019). Ribó-Pérez and colleagues (2021), in turn, showed that when user flexibility schemes do not account for individual differences. The differences in abilities and opportunities to provide flexibility risk exclude a significant segment of the users. In essence, if flexibility solutions are not diversified, there is a risk that they end up exacerbating economic inequalities. Thus, user flexibility schemes must be designed with both enabling and limiting factors in mind so as to not unfairly reward some actors while punishing others (Ribó-Pérez et al., 2021). In relation to the energy justice implications of user flexibility, designing user flexibility schemes for diversity would remedy the risk of unequal terms for participation and entail fairer governance procedures, as designing for diversity would render the system more inclusive.

7.

William Rooster was devastated. His dream had come true, and yet, the dream was not his anymore. Rather, it now belonged to Smith & Smyth.

"How could you do this!?" demanded Rooster.

"Costs are too high, Rooster," said Mr. Smith.

"We must think of the shareholders," said Mr. Smyth.

"But you are firing me… what about our agreement?" persisted Rooster.

"We promised to take Rooster Consultancy Inc. public," said Mr. Smith.

"We have delivered nothing more, nothing less," said Mr. Smyth.

"But Rooster Consultancy Inc. was my company… what am I supposed to do now?" said Rooster.

"Efficiency and productivity are key," said Mr. Smith.

"Try to be more flexible, Rooster," said Mr. Smyth.

B. Bartleby was labouring away at this desk. Mr. Bartleby was a very dedicated worker and prided himself on his high work morale. He woke up early morning to get a head start on the day, and he did not stop working until late in the evening. Mr. Bartleby worked for a global consultancy company, that had, like so many other enterprises these days, a platform-economy-based business model. As an associate of this multinational enterprise, Mr. Bartleby felt very privileged. Their business model gave him the freedom to set his own hours and work from wherever he wished. At least, that was what he had been told. In reality, however, Bartleby worked the regular nine-to-five hours, and maybe even more overtime now than before the takeover by Smith & Smyth.

Mr. Bartleby had trouble understanding his new working environment. Why self-employment was more favourable to him than a position at Rooster Consultancy Inc. he did not know. He gave little for the buzzwords that went around – efficiency, productivity, flexibility. What he cared for was his task at hand and his dedication to it. But still, he had to admit that having a job was better than having no job at all. And in that regard, he was content.

7 The future of user flexibility

I have now reached the concluding chapter of my thesis – the end of the story – and I will summarize my findings. The aim of this thesis was to contribute to knowledge on the potential energy justice implications of user flexibility by looking at the ways in which it affects certain aspects of everyday life. The aim was also to explore how user flexibility is understood by various stakeholders and made sense of within the energy transition. My conclusions align with my initial problem statement that 'an electricity system that relies on the flexibility of its users to remain operational risks creating a more unjust energy transition', depending on how it is implemented.

To achieve my aim of contributing to a better understanding of the potential energy justice implications of user flexibility and of how user flexibility is understood within the energy transition to a low-carbon society, I posed the following three research questions, which are answered below:

> **RQ1** How does the concept of flexibility capital inform the energy justice framework?

The concept of flexibility capital builds on Bourdieu's (1986) theories of symbolic capital and is concerned with resources and capacities. Identifying these assets enables an analysis of their distribution across society and among various stakeholders (distributional justice). The analysis identifies and recognizes the potential limitations of stakeholders, and the ways in which they either benefit or are at a disadvantage when entering a user flexibility scheme (recognition justice). By considering the mechanisms that distribute (and redistribute) the benefits and burdens of flexibility, the flexibility capital concept also provides insight into potential procedural injustices (procedural justice). Given that the flexibility capital concept feeds into an analysis of distributional justice, recognition justice, and procedural justice, the concept can be said to constitute a sub-genre of energy justice that specifically looks at user flexibility.

The goal of energy justice is to advance energy democracy, alleviate energy insecurity, reduce the energy burden, and alleviate energy poverty (Baker et al., 2019). The flexibility capital concept can contribute to the goals of advancing energy democracy and reducing energy burden by identifying how the distributions of resources and capacities either benefits or burdens the users, by using user profiles to identify privileged and disadvantaged actors, and by providing an

understanding of the political and economic mechanisms that result in uneven distribution. Similar to how the energy justice framework constitutes both a normative and analytical tool, the flexibility capital concept provides an analysis of individual resources and capacities that come with normative implications, for it implicitly advocates for fairer distribution of resources.

> **RQ2** What are the potential benefits and disadvantages of user flexibility from an energy justice perspective?

User flexibility seeks to engineer a more sustainable energy system by involving the user in the production and consumption of electricity. User flexibility is also one component of decentralized systems that localize the governance of electricity systems. These cross-sectoral collaborations between local actors and users may potentially contribute to a more inclusive energy sector. Including the users in the operation of the system may potentially also increase representation, thereby contributing to more democratic processes of governance (Alanne & Saari, 2006). User flexibility may also be used as a political strategy for targeting energy injustices and social equity. Previous research has demonstrated how government-supported initiatives can localize energy and generate value for vulnerable communities that otherwise would have been left out of the energy transition (Stewart, 2023).

However, depending on the level of reliance on market mechanisms for facilitating user flexibility, such schemes may potentially also come with a set of energy justice disadvantages. As I have outlined in this thesis, there is a risk that user flexibility schemes based on market principles may cause 1) a redistribution of wealth that will mainly benefit already affluent users; 2) a redistribution of economic responsibility that will shift economic risks from incumbent actors to end-users; 3) participation on unequal terms; 4) systems structures and functions that mainly benefit economically strong actors and users; 5) increased system complexity in a manner that is particularly disadvantageous for non-involved users; and 6) diluted transparency and accountability.

> **RQ3** How do various stakeholders (public news media, industry experts, and electric vehicle users) characterize and emphasize the key themes associated with user flexibility in the context of the energy transition?

In my exploration of RQ3, I demonstrated that the portrayal of user flexibility in the public news media to a large extent corresponds to the opinions of industry experts and electric vehicle users. In general, user flexibility was positively framed and perceived as one of several measures that will facilitate the energy transition. These stakeholders advocated for user flexibility by depicting it as a means of increasing the share of renewables in the energy mix, as a more economical option than building new infrastructure (and even as a financial opportunity), as a means of

facilitating more efficient uses of existing infrastructure, and as a more democratic form of electricity consumption. The prevalence of these sentiments among individuals and in the public consciousness provides further evidence for the dominance of technical and economic perspectives on the energy transition (Ingeborgrud et al., 2020).

In conclusion, the findings of this thesis showcase the need for greater integration of social perspectives in energy policy in order to avoid potential energy justice pitfalls. Future research should investigate the ways in which energy policies can do more to incorporate social perspectives so as to avoid one-sided or simplified understandings of user flexibility. Future research should also seek to diversify the range of options for user flexibility. Previous research has demonstrated that due to the different abilities and capacities of users, user flexibility schemes should be designed with the most vulnerable groups in mind in order to avoid financially harming or excluding them (Ribó-Pérez et al., 2021; White & Sintov, 2019). Another avenue of research is the exploration of non-financial and non-market-oriented incentives for facilitating user flexibility. Past research has concluded that there are several other potential motivational drivers for incentivizing user flexibility that could avert the risks mentioned in this thesis (Bartusch et al., 2024; Pratt & Erickson, 2020). Lastly, future research should also investigate the possibilities of using user flexibility as a political strategy for targeting social inequalities (Stewart, 2023).

7.1 On storytelling

On a final note, I would like to address the fictional abstract and my rationale for including it in the thesis. In case the story has gone unnoticed, the fictional abstract constitutes a cautionary tale (Tyszczuk, 2014) about the impacts of flexibilization, marketization, and capital concentration on everyday life. Throughout the story, the protagonist Mr. Bartleby is being increasingly challenged by a system that requires him to be more and more flexible. Changes to the system based on economic rationality are disguised as opportunities for Mr. Bartleby with the help of buzzwords. His attempts to comply with these changes take a toll on his health and his finances, and he is paying the costs for Rooster Consultancy's pursuit of profit. The company transfers its financial burdens to its employees in the same way as user flexibility based on market principles may redistribute economic costs and risk diluting accountability. As this happens, Mr. Bartleby's only means of coping is to make social rearrangements to his private life to suit the new conditions.

'Hold on,' someone might say. 'These are two different forms of flexibility.' They'd be right. The fictional abstract depicts a 'flexibilized' form of production, whereas the thesis investigates 'flexibilized' forms of consumption. However, juxtaposing

flexible production and flexible consumption has been proposed as an insightful approach to understanding the implications of normalizing flexibility in social domains (Fell et al., 2023; Powells & Fell, 2019). Flexibility blurs the lines between labour and behaviour, public and private, work and leisure. Scrutinizing the effects of flexible labour should provide warnings about enrolling users in flexible consumption schemes (Fell et al., 2023) and encourage questions about whether it is right to instrumentalize people and their behaviours to uphold socio-technical systems, particularly if the aim of these systems is to generate profit (Powells & Fell, 2019).

The fictional abstract is my attempt at posing these questions in a creative format that is accessible to a wider audience while also challenging the conventional appearance of a doctoral thesis. My ambition has been to make this thesis and its findings accessible, not only to the scientific community, but also to a non-academic audience. Storytelling is a medium for conveying information in an accessible way as it can portray people and events in ways that require no prior technical knowledge. Storytelling in general, and prose in particular, allow the author to explore and convey manners, actions, and motives, and it grants the audience a holistic perspective on events, since they can be explored both subjectively and objectively through first- and third-person perspectives (Raven, 2017; Smith et al., 2017). Thus, if my fictional abstract induces someone to pick up my thesis, someone who would not have done so otherwise, I will feel I have succeeded.

While working on this thesis, I realized that I wanted it to be a work of art as much as a work of science. Writing the fictional abstract has been a creative outlet and has provided me with much-needed refreshment every now and then during my work. I do not know what the future holds, and this thesis may be the only opportunity I ever have to write a book. Should this be the case, then I want this thesis to be not just a work of science, but also a work of art, to honour my parents and the stories they read to me as a child that have inspired me to write.

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Epilogue

There was a spring in their steps as they walked down the lane. Mr. Smith and Mr. Smyth were merry. They were on their way to the bank to cash in the check that rested in Mr Smith's briefcase.

"This is a lovely day," said Mr. Smith.

"Indeed, this day is lovely," said Mr. Smyth, and they both laughed.

Smith & Smyth continued laughing. And they laughed all the way to the bank.