Wiring Power

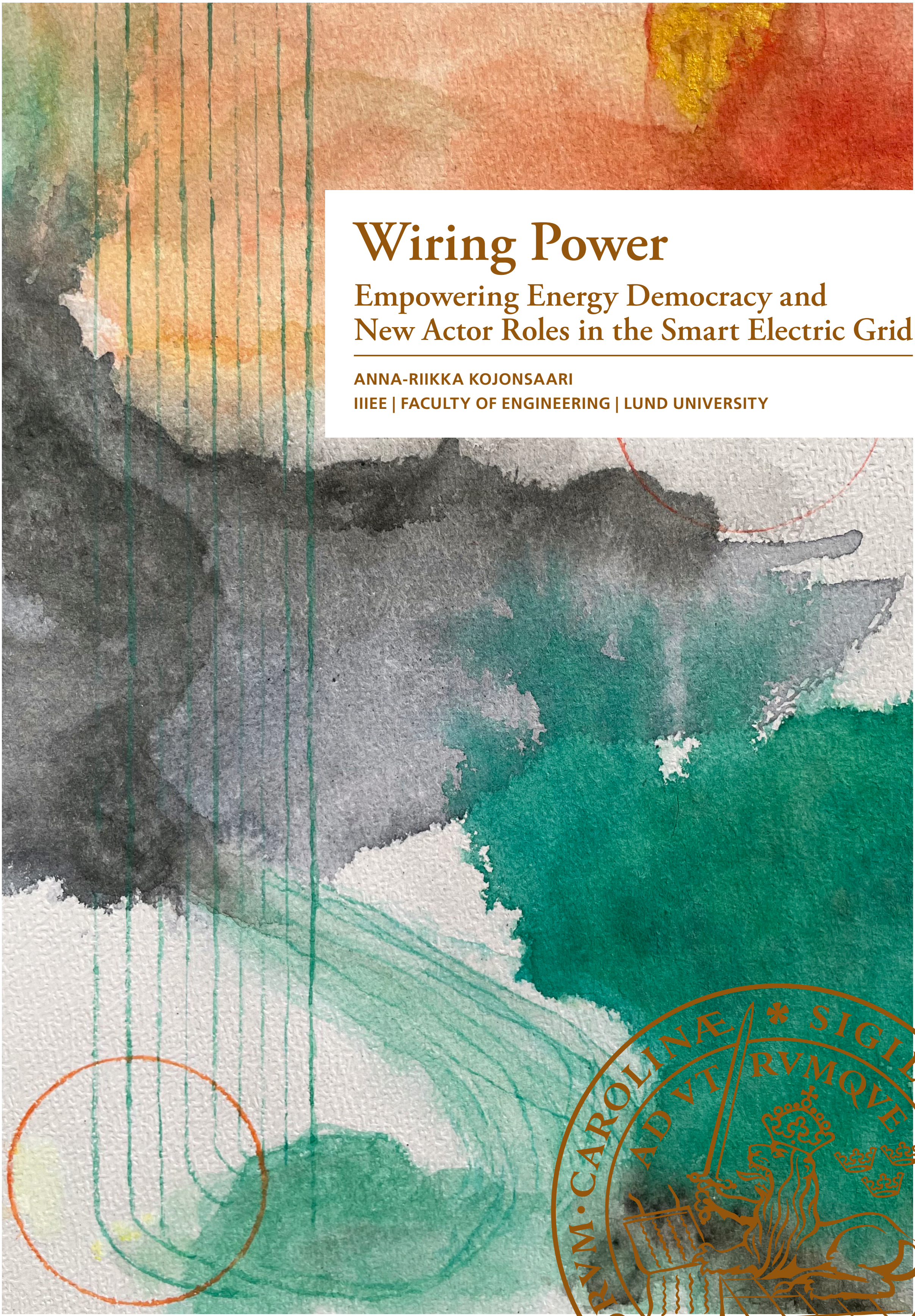
Empowering Energy Democracy and New Actor Roles in the Smart Electric Grid

Kojonsaari, Anna-Riikka

2025

LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00



Wiring Power

Empowering Energy Democracy and New Actor Roles in the Smart Electric Grid

ANNA-RIIKKA KOJONSAARI
IIIEE | FACULTY OF ENGINEERING | LUND UNIVERSITY

Wiring Power: Empowering Energy Democracy and New Actor Roles in the Smart Electric Grid

Wiring Power

Empowering Energy Democracy and New Actor Roles in the Smart Electric Grid

A.-R. Kojonsaari

DOCTORAL DISSERTATION

by due permission of the Faculty of Engineering, Lund University, Sweden.
To be publicly defended at the International Institute for Industrial Environmental Economics, Aula, 25 April 2025 at 13:00.

Faculty opponent
Professor Tomas Moe Skjølsvold
Norwegian University of Science and Technology, Norway

Organization: LUND UNIVERSITY

Document name: Doctoral thesis

Date of issue: the 25th of April 2025

Author: Anna-Riikka Kojonsaari

Sponsoring organization:

Title and subtitle: Wiring Power: Empowering Energy Democracy and New Actor Roles in the Smart Electric Grid

Abstract: The global energy transition is not merely a technological shift toward renewable energy but also a transformation of power structures, agency, and governance. As nations and cities implement sustainable energy solutions, both traditional energy actors and new entrants are reshaping participation in the energy sector. Within this evolving context, the smart grid emerges as an arena where these dynamics unfold.

This thesis examines five local smart electricity grid cases in Sweden, including two urban smart grid projects, two energy community initiatives, and a local flexibility market demonstration project. Using qualitative methods, including participant observation, interviews, document analysis, and literature reviews, the study provides an in-depth exploration of the barriers and drivers encountered by professional actors in local smart grid development.

The analysis reveals several barriers for professionals working with smart grid development, such as regulatory constraints, financial uncertainties, and role conflicts. Key enabling factors, on the other hand, include municipal leadership, organizational champions, aggregator support, the acknowledgment of timing, and windows of opportunity in the energy planning processes. The role of a missing stakeholder group—the citizens—is also discussed, as is how the stakeholders' different interpretations of "smart grids" can lead to different project outcomes.

Keywords: smart grid, socio-technical systems, energy democracy, energy governance, actor roles, decentralization.

Classification system and/or index terms (if any)

Supplementary bibliographical information

Language: English

ISSN and key title: 1402-3016

ISBN: 978-91-988626-3-8 printed, 978-91-988626-2-1 digital

Number of pages: 164

Signature:

Date 2025-03-07

Wiring Power

Empowering Energy Democracy and New Actor Roles in the Smart Electric Grid

A.-R. Kojonsaari

LUND UNIVERSITY

Faculty of Engineering
International Institute for Industrial Environmental Economics (IIIEE) at Lund University

ISBN: 978-91-988626-3-8 printed, 978-91-988626-2-1 digital
ISSN 1402-3016

Printed in Sweden by Media-Tryck, Lund University
Lund 2025

To Freija and Jonathan

Table of contents

Abstract

The global energy transition is not merely a technological shift toward renewable energy but also a transformation of power structures, agency, and governance. As nations and cities implement sustainable energy solutions, both traditional energy actors and new entrants are reshaping participation in the energy sector. Within this evolving context, the smart grid emerges as an arena where these dynamics unfold.

This thesis examines five local smart electricity grid cases in Sweden, including two urban smart grid projects, two energy community initiatives, and a local flexibility market demonstration project. Using qualitative methods, including participant observation, interviews, document analysis, and literature reviews, the study provides an in-depth exploration of the barriers and drivers encountered by professional actors in local smart grid development.

The analysis reveals several barriers for professionals working with smart grid development, such as regulatory constraints, financial uncertainties, and role conflicts. Key enabling factors, on the other hand, include municipal leadership, organizational champions, aggregator support, the acknowledgment of timing, and windows of opportunity in the energy planning processes. The role of a missing stakeholder group—the citizens—is also discussed, as is how the stakeholders' different interpretations of "smart grids" can lead to different project outcomes.

Popular Science Summary

Since the start of the Industrial Revolution, the burning of fossil fuels has caused the planet to heat up. Due to this overheating and ensuing climate change, there is a need to phase out the use of fossil fuels and transition towards more renewable energy sources. This means that the structure of our energy system changes from the traditional centralized production of fossil energy to a more decentralized production of renewable energy, closer to the consumer side. This sustainable transformation requires extensive coordination, where the so-called smart grid can aid. Smart grid means a variety of information technology solutions that help to coordinate different grid functions. With the transition to a smart grid, the planning of the entire electricity grid goes through a change with new actor roles and emerging actors. For example, the role of municipalities and electricity utilities evolve.

This thesis examines this transition in Sweden from a socio-technical perspective that views not only the wires and the grid but the wider implications of this physical artifact in its social environment. This refers to the different actors participating and coordinating the smart grid because numbers can only tell part of the story. Focusing on the professional actors' perceptions and experiences, this study produces findings that shed light on what the energy transition *means* for the different professional actors and how they experience their changing roles, and what kind of barriers and drivers they meet along the way towards a more sustainable electric system.

Finally, the concept of energy democracy is used to explain the gathered evidence. In short, energy democracy aims to examine the rules, roles, and processes around the energy system that moves from centralized to decentralized. Governance is about steering the ship, and energy democracy aims to help to steer the energy system towards a more democratic system for everyone. This thesis contributes to one piece of the picture by focusing on the professional actors. The findings show that there are different kinds of struggles that pose challenges to the planning of the smart grid, such as struggles regarding representation and interpretation of the participating actors' different roles and responsibilities together with conflicting values. Finally, opportunities for enhancing energy democracy are identified to build a common ground to face these challenges.

Acknowledgements

I am deeply grateful to my supervisor, Jenny Palm, for believing in me from the very beginning. Your trust in my potential and your decision to bring me onto this journey have meant the world to me. Thank you for your unwavering support, guidance, and encouragement throughout this process. Your mentorship has shaped not only my academic growth but also my confidence in navigating this field. I could not have asked for a better supervisor.

Daniela Lazoroska, you entered the picture at exactly the right moment. Thank you for stepping in as my co-supervisor at the perfect time. Your uplifting demeanor and humor make work feel like fun, yet in the midst of all the laughter, you have an incredible ability to pinpoint the most crucial insights in just a few words—helping me move forward in my work. That is a rare talent. Together, you and Jenny made an amazing team—I could not have asked for better supervisors.

A special thank you also to Lena Neij, who has not only offered me valuable advice throughout the PhD journey but also fine dark chocolate—both arriving at just the right moments, for which I am truly grateful. Thank you for making the PhD journey more pleasant in stressful times.

To everyone at IIIEE—colleagues, staff, and students, both past and present—I deeply appreciate you all. In no particular order, my thanks go to Yuliya, Lena, Oksana, Luis, Per, Åke, Calle, Håkan, Philip, Andrius, Aleh, Thomas, Jessika, Berni, Matthias, Lotta, Kes, Samson, Georgios, Lars, Björn, Katharina, Sofie, Vera, Jenny von P, Aleks, Joel, Hanna and Jenny L. (a big thank you for all your help!), Margaret, Marianne, Patricia, Emelie, Lilly, Ella, and my current fellow doctoral students: Karolina, Gustav, Emma, Lisa, Katherine, Philipp, Josefine, and Andrea.

To all my former colleagues, especially Frans, Ana, Julia, Ellen, Roland, Heather, Patrick, Lars, Naoko, and many more—thank you. And to all the students at the institute whom I have had the pleasure of interacting with, teaching, and learning from—you have been a source of inspiration. I am in awe of how talented you are.

I am also deeply grateful for the care, support, and kindness of our beloved caregiver, Anders Engberg—not only for his dedication to the building but, most of all, for his care toward the staff. He will be dearly missed and always remembered.

A heartfelt thank you to the Kamprad Family Foundation. The Resistance and Effect project has grown into a research hub where I have had the honor of being guided by esteemed professors and colleagues. I am also deeply grateful to all the informants who made this research possible.

A special thank you to Harald Rohracher, my excellent opponent at the final seminar, and Dick Magnusson, my brilliant opponent at the mid-way seminar. Your wisdom and insightful questions greatly helped me advance my work.

Special thanks to colleagues in Uppsala, Cajsa Bartusch and Fouad El Gohary, for offering encouragement and wisdom. Thank you also to Isak Öhrlund and Nina Fowler for their excellent collaboration during the challenges of the COVID-19 pandemic.

Thank you to Friends and Family—in Finland and Sweden, old and new, present and remembered; I would have not been able to do this without you:

Mom and Dad, thank you for your unwavering support. My brothers, Lauri and Mikko-Matti, I am grateful for your encouragement. A heartfelt thank you also to Asta, Ilmari, Armas, and Aarne. Even though I have not seen you as much as I would have liked during this period of my life, you have been with me in spirit every step of the way. My dearest grandparents—Brita, Mikko, Leena, and Antti—and my beloved godmother, Heta, your presence and love have always been a source of strength.

Thank you, Citte and Peter, for your generosity and for always showing up for support and help. Frida and Lucas, for your delightful presence in family gatherings. Pauliina, thank you for all the wonderful times we've shared and for your amazing ability to not only listen but also hear others. Jasmin, thank you for your enormous kindness and supporting words throughout—you have helped me move forward—literally every day ;) Thank you.

To my creative ally in academia, Marthe. Thank you, Rosa, for your encouragement, inspiration and insights. I am grateful to have you and Jaakko in my life. Thank you, Riikka and Inka, for all the support throughout the years. And to all the incredible women of Forssajengi—you continue to inspire me year after year. A safety net that catches you if you fall and lifts you right back up—what a gift. Special thanks also to Maria for her gracious support.

Finally, Freija, and Jonathan, when you smile, the world is brighter. You have taught me more than you can ever imagine. Thank you for your support.

Anna-Riikka

Lund, February 2025

Abbreviations

EC	Energy community
Ei	The Swedish Energy Markets Inspectorate
EU	European Union
IPCC	Intergovernmental Panel on Climate Change
LFM	Local flexibility market
RQ	Research question
Svk	Svenska Kraftnät

Preface

This research was conducted at the International Institute for Industrial Environmental Economics (IIIEE) at Lund University. The IIIEE is a unique research hub dedicated to interdisciplinary research aimed at advancing sustainable solutions. Established in 1994, the IIIEE also provides education as an integral part of Lund University.

Power here can be interpreted in multiple ways. The technical complexity of the electricity system often excludes those without an engineering background, yet the energy transition demands a broad understanding. Communication around the electricity system is a challenge even for experts. Although this thesis does not fall within communication studies, I see public communication as essential for making knowledge accessible, especially as a first-generation PhD student. As the saying goes, knowledge is power.

This PhD project was part of *Resistance and Effect – on Smart grids for the Many People* (2019–2024), funded by the Kamprad Family Foundation (grant number 20182014). The project identified smart grids as a key research area and was led by Professors Jenny Palm, Harald Rohracher, Ulf Melin, Björn Sanden, Cajsa Bartusch Kätting, and Cecilia Katzeff, as well as other researchers across Sweden. A reference group included representatives from Ellevio, the Swedish Energy Agency, the Kamprad Family Foundation, the Swedish Energy Markets Inspectorate, Hyresbostäder i Norrköping, and the Swedish Consumer Energy Markets Bureau.

I hope you enjoy your reading!

List of Papers

Paper I

Kojonsaari, A.-R. and Palm, J. (2023). The development of social science research on smart grids: a semi-structured literature review. Energy, Sustainability and Society, 13(1). https://doi.org/10.1186/s13705-023-00381-9

Paper II

Palm, J., **Kojonsaari, A.-R.**, Öhrlund, I., Fowler, N. & Bartusch, C. (2023). Drivers and barriers to participation in Sweden's local flexibility markets for electricity. Utilities Policy, 82, Article 101580. https://doi.org/10.1016/j.jup.2023.101580

Paper III

Kojonsaari, A.-R. and Palm, J. (2021). Distributed energy systems and energy communities under negotiation. Technology and Economics of Smart grids and Sustainable Energy, 6(1), Article 17. https://doi.org/10.1007/s40866-021-00116-9

Paper IV

Kojonsaari, A.-R., Palm, J. & Lazoroska, D. (Manuscript). Timing in Energy Planning of Sustainable City Districts: Windows of Opportunities and Lost Potential.

Paper V

Palm, J., **Kojonsaari, A.-R.** & Magnusson, D. (2025). Toward energy democracy: municipal energy actions in local renewable energy projects. Energy Research and Social Science. https://doi.org/10.1016/j.erss.2025.103921

Author’s contribution to the Papers

Paper I

Anna-Riikka Kojonsaari (ARK): Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. JP: Writing – original draft, Writing – review & editing.

ARK developed the idea, research design and gathered data and did the mail part of the analysis. Both co-authors wrote the Paper and revised it pursuant to peer reviewer comments.

Paper II

ARK: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. JP: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing IÖ: Investigation, Formal analysis, Writing – review & editing NF: Investigation, Formal analysis, Writing – review & editing CB: Investigation, Writing – review & editing.

ARK gathered data jointly with the co-authors. ARK and JP developed the analytical framework. ARK began as the first author but transferred the role to JP upon taking parental leave. All contributed to the formal analysis and in revising the Paper. J.P. revised the Paper pursuant to peer reviewer comments in discussion with the other co-authors.

Paper III

ARK & JP: Conceptualization, Methodology, Data gathering, Investigation, Formal analysis, Writing – original draft, Writing – review & editing.

Both co-authors participated in all parts of the Paper.

Paper IV

ARK: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. JP: Writing original draft, Writing – review & editing. DL: Writing review & editing.

ARK developed the idea, research design and analysis in discussion with J.P. ARK. gathered data and wrote it together with J.P. with input and comments from D.L.

Paper V

ARK: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing. JP: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing.

DM: Conceptualization, Investigation, Formal analysis, Writing – original draft, Writing – review & editing.

All co-authors participated in all parts of the Paper. JP is listed as the first author due to assuming a slightly greater responsibility for the overall development of the manuscript.

Other publications and conference proceedings

Journal publications

Lazoroska, D., Palm, J, and **Kojonsaari, A.-R.** (2024). The gender structure of opportunities in the energy sector: a literature review on women's networking and mentoring. *Energy, Sustainability and Society*. https://doi.org/10.1186/s13705-024-00494-9

Chapter, book of abstracts

Palm, J. and **Kojonsaari, A.-R.** (2025). Energy democracy, energy justice and energy citizenship – citizen participation in theory and practice. *NESS2024 book of abstracts.* Presented in Workshop 16: Repower the people? The role of citizens in accelerating energy transition.

Selected blog posts

Kojonsaari, A.-R. (2023, January 25). Do we need more social science studies focusing on smart grids? The short answer is yes. Retrieved from: https://iiieeenergyblog.wordpress.com/2023/01/25/do-we-need-more-social-science-studies-focusing-on-smart-grids-the-short-answer-is-yes/

Kojonsaari, A.-R. (2022, March 21). Ways toward more decentralized energy system: the case of a microgrid. Retrieved from: https://iiieeenergyblog.wordpress.com/2022/03/21/ways-toward-more-decentralized-energy-system-the-case-of-a-microgrid/

Lazoroska, D. and **Kojonsaari, A.-R.** (2023, August 22). Acts of care: the winding road of public research communication and recognizing the invisible relational labor and resources. Retrieved from:

https://iiieeenergyblog.wordpress.com/2023/08/22/acts-of-care-the-winding-road-of-public-research-communication-and-recognizing-the-invisible-relational-labor-and-resources-part-1-2/

Introduction

Because electricity's infrastructures are physically heavy, costly, and enduring, their configuration continues to remind observers of who holds power

(Winther & Wilhite, 2015, p. 572).

Human action, such as the usage of fossil fuels such as oil, coal, and natural gas exceeds the Earth's capacity to sustain it (Rockström et al., 2009). Since the dawn of the global Industrial Revolution, the burning of fossil fuels has significantly contributed to atmospheric heating, resulting in climate change and an urgent need to transition away from fossil fuels toward renewable energy sources (IPCC, 2021). There is an urgent need to accelerate the deployment of renewable energy sources to fulfill the European Union's (EU) commitment to climate neutrality by 2050, a goal at the core of the European Green Deal driven by the challenges of atmospheric warming and the climate change (European Commission, 2019a).

The global energy transition is not merely a technological shift; it represents a transformation in the social structures regarding power, agency, and governance. Within this transition, traditional energy actors and new entrants are reshaping the landscape of participation. Within the complexity of the energy transition (Sovacool & Geels, 2016), the smart grid takes center stage as a key element in the shift toward more sustainable energy systems.

Despite its potential to decentralize control and empower citizens, smart grid development has been largely examined from technical and economic perspectives, leaving energy democracy considerations relatively underexplored (Kojonsaari & Palm, 2023). Smart grid enables the integration of information technology and artificial intelligence to optimize energy distribution, ensuring a more sustainable, economical, and secure electricity supply (European Smart grids Technology Platform, n.d.). Through processes of learning, adaptation, and information exchange (Powell et al., 2024), the smart grid enables active user participation, yet crucial questions of governance and power remain relatively unexplored. The challenge is further compounded by the lack of a clear definition of the smart grid (Kojonsaari & Palm, 2023), as well as the diverse implementation pathways, which carry distinct values leading to different outcomes (Palm et al., 2025).

Energy democracy offers a critical lens for understanding this transition. Fundamental concerns of energy democracy include questions of who controls the means of energy production and consumption (Stephens, 2019), the role of collective prosumerism and cooperatives as crucial steps toward the democratization of energy systems (Wahlund & Palm, 2022), the shift from passive consumers to active participants (McKasy & Yeo, 2021), and amplifying citizens' voices in energy governance (Clarke, 2017).

This thesis addresses this gap by analysing empirical data from five local cases, which represent different pathways of smart grid development in Sweden. The data is analysed with the help of a conceptual and analytical framework consisting of a socio-technical systems framework (Hughes, 1987), which provides a macro-level perspective, recognizing that energy infrastructure is embedded within broader social, political, and economic contexts. The energy democracy framework highlights governance struggles and participation challenges, while the concept of roles (i.e., Mead, 1934; Linton, 1936; Biddle, 1986; Wittmayer et al., 2017) offers a micro-level understanding of actor agency, clarifying how stakeholders negotiate governance roles in practice. Combined, these frameworks and concepts offer a comprehensive analysis of how smart grids are governed, who participates, and what kind of barriers the experts perceive to exist.

Sweden provides a compelling case for this research, given its strong commitment to sustainability. Examining how different professional actors engage in smart grid development at the local level reveals the practical implications of this transformation. This thesis adopts Wolsink's (2012) definition of the smart grids "a socio-technical network characterized by the active management of both information and energy flows, in order to control practices of distributed generation, storage, consumption, and flexible demand" (p. 824). The smart grid is not just a technical system but also includes actors, institutions, and infrastructures (Hojckova et al., 2018). By examining the interactions of the actors within it, this research sheds light on the governance of local smart grids and the evolving roles of those involved in their planning and implementation.

Research problem

While the EU has established policy frameworks such as the Clean Energy Package to support the energy transition, the policies are designed at the top level and must be adapted to diverse local conditions. The smart grids have been introduced to tackle key policy challenges, including rising electricity prices, intermittent energy supply, and environmental sustainability (Lovell, 2022), while also increasing automation and control over the grid (Ballo, 2015).

However, as Listerborn and Neergaard (2021) note, friction emerges when ambitious visions encounter local realities. The smart city discourse, in general, is often presented in a decontextualized manner, failing to account for the specific local conditions in which they unfold (e.g., Karvonen et al., 2019; Listerborn & Neergaard, 2021). The tension between top-down policy implementation and local governance structures raises critical questions about decision-making, collaboration, and participation in smart grid projects. Existing literature on smart grids frequently emphasizes normative goals, such as direct citizen participation through energy communities (ECs), while overlooking the broader role of municipal structures in advancing energy democracy. Furthermore, it has been suggested in previous research that one reason why the smart grid projects have not fulfilled the professionals is that the public has frequently been excluded from discussions and decision-making processes surrounding smart grid development (Hargreaves et al., 2022).

Despite its potential to democratize energy transitions, energy democracy remains largely underexplored in smart grid research. Furthermore, the research on energy democracy has overlooked the question of whether energy democracy occurs at the local, regional, or national level or across all three (Busch et al., 2023). Previous research has primarily focused on the technological aspects of smart grids, the policy frameworks driving their implementation, and the role of citizens as prosumers. Prosumers, individuals or entities that both generate and consume energy simultaneously, have been a focus of inquiry (Parag & Sovacool, 2016). However, significant research gaps remain, particularly regarding the evolving role of professional actors in governing and shaping smart grid transitions, the negotiation of roles and governance responsibilities in local smart grid initiatives, and the barriers to cooperation and participation within local smart grid projects. Additionally, there is limited research on indirect participation in energy democracy beyond ECs.

This thesis aims to address some of these gaps by bridging smart grids with energy democracy and exploring how different professional actors influence the planning and implementation of local smart grid projects in Sweden, particularly examining the barriers for local smart grid development. This thesis advances the understanding of how various actors engage in different local smart grid projects in Sweden by identifying the perceived roles and barriers the professionals face in the local smart grid development projects and exploring how these findings can be understood from the perspective of democratic energy governance. This is achieved by tackling local energy planning challenges through a developed multi-level framework, with a focus on the evolving roles of professional actors in local smart grid projects. The thesis applies the concept of roles from social interaction research (Mead, 1934; Linton, 1936; Biddle, 1986; Wittmayer et al., 2017) to investigate how actors negotiate the planning process and how role conflicts influence decision-making in smart grid projects. By applying the energy democracy framework to smart grid governance, this thesis explores questions of representation, inclusion, and decision-making power in smart grid projects.

The sustainable energy transition toward smart grids has been extensively studied from technological and policy perspectives. However, research on the governance of smart grids remains contested, with unresolved questions about power dynamics, actor roles, and citizen participation. The different actors included in the smart grid projects face different types of barriers that might hinder cooperation. The actors' evolving roles and their interrelations require thorough empirical investigation. The empirical data consists of five local cases examining different actor constellations and their experiences of participating in these projects in Sweden. The data were collected on the involvement of professional actors in the planning and implementation of local smart grid projects.

More specifically, energy democracy refers to the principle that people should have a role in shaping how energy is produced and distributed, and it is primarily used to discuss both real-world cases and theoretical models of inclusive decision-making in energy communities, emphasizing who participates in governance and how decisions are made emphasizing both direct and indirect participation in decision-making processes (Wahlund & Palm, 2022). Its goal has been to shift economic and decision-making power by transforming citizens into active participants, key stakeholders, and accountable members within the energy sector (Szulecki, 2018). However, the often-overlooked role of indirect participation, such as through municipal structures, for smart grid development requires further examination.

When I began fieldwork and observed various planning processes and local flexibility markets, it quickly became evident that professional actors primarily drove these activities. However, I also found it important to reflect on the absence of citizens in energy planning processes, an aspect that has been lifted in previous research (e.g., Hargreaves et al., 2022). While the research questions focus on professional actors, this analysis is framed through the lens of energy democracy, an area that remains relatively underexplored. Incorporating energy democracy into the conceptual and analytical framework enables a discussion on the missing role of citizens in the smart grid projects. Although this is not the central focus of the study, it emerged as a significant observation that warranted attention in the thesis.

Research objectives and questions

This thesis explores the governance challenges of Sweden’s energy transition toward a smart electric grid, focusing on the roles of municipalities, distribution system operators, property developers, and emerging actors such as energy communities, flexibility service providers, and aggregators. Here, roles are analysed as a socio-technical dimension of smart grid development.

In this sense, professionals play a central role in municipal projects, and this thesis examines them as potential enablers of energy democracy, exploring their relationship with energy democracy, whether they contribute to it, and whether their role and empowerment are integral to energy democracy.

The thesis poses the following research questions:

RQ1: Which professional actors are involved in the studied local energy planning and local flexibility markets?

RQ2: How do these professional actors perceive and navigate barriers in local smart grid development?

RQ3: What are the implications of evolving actor roles for democratic energy governance?

The first question aims to identify why specific professional actors are involved in the local smart grid projects in Sweden. The second question is important because it investigates how the professionals perceive and encounter barriers within the local contexts of smart grid development, with the local energy planning projects and local flexibility markets as examples. The third question ties the planning processes of smart grids and energy democracy, analysing the local cases through the lens of energy democracy and examining the connections between these processes and democratic principles to bring novel insights.

The study employs a multiple-case study methodology, focusing on five local smart grid cases in Sweden. The main data collection methods include semi-structured interviews, participant observations, and document studies. The analysis is conducted using a combination of semi-structured literature review and qualitative analysis to ensure depth and rigour in addressing the research objectives.

Overview of Papers

The thesis consists of five peer-reviewed original research articles, referred to as Papers in the thesis, published in academic journals. They are structured in a logical order that serves the aim of the thesis. The literature review in Paper I provided the foundation for the subsequent Papers and helped identify key research gaps that helped to shape the study's focus on representation and participation, particularly within smart grid governance structures and energy democracy. Papers II-IV explore specific local conditions influencing energy planning projects and local flexibility markets, while Paper V examines the roles of municipalities and municipally owned energy utilities in shaping energy transitions. A brief overview of these Papers is presented in Table 1 after the descriptions.

Paper I: The Development of Social Science Research on Smart Grids: A Semi-Structured Literature Review (2023)

Paper I reviews how social science studies have engaged with smart grids through a literature review of peer-reviewed articles retrieved from Web of Science and Scopus up to 2022. The aim was to explore the types of knowledge produced, with a focus on various themes. It maps the academic field around the social science studies of smart grids to make sense of the development of the field and the research gaps. With the defined search term "smart grid" entered into Scopus and Web of Science, 1,352 Papers were sorted, of which 1,137 were screened. After removing most of the Papers with the exclusion criteria, for example, if no social science was included, the number of articles was reduced to 111, and these were included in the qualitative synthesis. This process has its limitations, and due to the sheer number of articles, some concentrated decisions regarding the exclusion criteria needed to be made to produce a qualitative, semi-structured literature review.

The findings based on the 111 articles showed that knowledge development followed a pattern where visions were studied first, then professionals and users, and smart technologies in homes. The geographical focus was mainly on Europe and the USA. Six research gaps were identified: 1) the obvious gap regarding the dominant Western focus of the studies; 2) the definitions of smart grids; 3) resistance and non-participation; 4) silent and marginalized actors; 5) the centralized-decentralized nexus of the smart grids, and 5) energy democracy and procedural aspects of participation.

Paper II: Drivers and Barriers to Participation in Sweden's Local Flexibility Markets for Electricity (2023)

The second Paper in the thesis focuses on the local flexibility markets (LFM) in Sweden, especially on the European Union Horizon 2020 project called CoordiNet. The empirical part of this Paper consists of 25 in-depth interviews (Kvale & Brinkmann, 2009) with enrolled and potential flexibility service providers of two LFMs in Sweden: CoordiNet Uppland and CoordiNet Skåne, both first tested in the winter of 2019-2020. The flexibility service providers are producers or consumers who may offer a certain level of flexibility at a particular time and price for the market (Minniti et al., 2018).

The aim of the Paper was to identify and analyze the barriers and drivers faced by the enrolled and potential service providers. The analysis revealed several barriers recognised as organisation and attitudes, economy, information, technology, social responsibility, policy and regulations, and LFM design. On one hand, for example, it was difficult for the service providers to understand all the regulations and permissions, there was a lack of incentives, and the costs might exceed the deemed benefits. On the other hand, drivers for participation included aspects such as an aggregator acting as a mediator between the buyer and the provider, public relations, personal engagement, and opportunities to learn and contribute to social responsibility.

Paper III: Distributed Energy Systems and Energy Communities Under Negotiation (2021)

The third article in the thesis examines the development of distributed energy systems and citizen energy communities through a case study of the energy planning process in Sege Park, Malmö, Sweden, where a microgrid was discussed. Drawing on participant observations and semi-structured interviews with property developers, municipal representatives, and distribution system operator representatives, the study identifies two different discourses around distributed energy systems and citizen energy communities and analyses them with the developed analytical framework around distributed energy systems and citizen energy community—the analytical framework compromised definition, purpose, control, ownership, system solutions, and values. The analytical framework aided in breaking down the two discourses, which allowed them to be analysed separately. In this way, the discourses could be viewed separately from one another yet analysed as parallel processes in the planning project. The Paper further discusses the different values in these discourses, what kind of consequences the identified values might have, and whether the various values were addressed in the planning process. In this sense, the Paper deliberately interprets the power dynamics that took place in the planning process.

Paper IV: Timing in Energy Planning of Sustainable City Districts: Windows of Opportunities and Lost Potential (manuscript)

The fourth Paper in the thesis explores the planning of Sege Park in Malmö, Sweden, a flagship project for climate-smart urban development. Despite high ambitions, key opportunities for transformative change, such as hiring a sustainability coordinator and establishing an energy community, were missed. The study analyses data gathered using document analysis, participant observations, and interviews. The Paper analyses factors such as unclear decision-making and poor timing and discusses what kind of effects these kinds of factors might have on the outcome of the project. The study discusses windows of opportunity and analyses lost potential in the planning process.

Paper V: Toward Energy Democracy: Municipal Energy Actions in Local Renewable Energy Projects (2025)

Municipalities and municipally owned energy utilities have traditionally played a prominent role in Scandinavian energy planning processes, which has implications for how citizens and other stakeholders perceive energy democracy and citizen participation. Thus, the fifth Paper of the thesis focuses on discussing energy democracy and citizen representation, on the one hand, when citizens are directly involved in a project and, on the other, when a municipality or a municipally owned energy utility represents them. The qualitative, multiple-case study method (Yin, 2009) draws from similar yet different empirical data from four different case studies, two energy community cases, and two urban development projects, which are analyzed as a single dataset. This data is compared and reanalyzed (Wästerfors et al., 2014) with the aim of developing new insights.

Thesis structure

The next section provides a brief overview of Sweden's electricity system. A presentation of the conceptual and analytical framework follows this contextual background. The following methodology section presents the research design. The thesis then moves on to present the findings from the case studies and then proceeds to discuss the findings' broader implications. Finally, the thesis ends with a concluding section.

Nº	Authors	Year	Title	Data and cases	Methods	Analytical focus	RQ
I	Kojonsaari, A.-R. & Palm, J.	2023	The Development of Social Science Research on Smart Grids: a Semi-Structured Literature Review	111 peer-reviewed articles	Literature review	Identifying the research gaps, reviewing the literature	1
II	Palm, J., Kojonsaari, A.-R., Öhrlund, I., Fowler, N. & Bartusch, C.	2023	Drivers and Barriers to Participation in Sweden's Local Flexibility Markets for Electricity	CoordiNet Uppland and Skåne	25 in-depth interviews	Barriers and enablers for participation in local flexibility markets, aggregators	1-3
III	Kojonsaari, A.-R. & Palm, J.	2021	Distributed Energy Systems and Energy Communities Under	Sege Park, Malmö	Semi-structured interviews, participant observations, literature research	Stakeholder participation, negotiations, planning process, EC and DES pathways	1, 2
IV	Kojonsaari, A.-R., Palm, J. & Lazoroska, D.	TBD	Timing in Energy Planning of Sustainable City Districts: Windows of Opportunities and Lost Potential	Sege Park, Malmö	15 semi-structured interviews, participant observations	The planning process, developers and municipality's roles, windows of opportunities	2, 3
V	Palm, J., Kojonsaari, A.-R. & Magnusson, D.	2025	Toward energy democracy: municipal energy actions in local renewable energy projects	Two urban development projects, two energy communities	Semi-structured interviews, participant observations	Energy democracy, representative and direct participation, the role of municipalities	2, 3

Table 1. Overview of the thesis Papers and their relation to the research questions.

Background

This section provides contextual background on the research problem by outlining the key elements of the Swedish electricity system, including policy frameworks, market structures, and key stakeholders that influence smart grid development. It begins with a brief overview of global challenges and then moves on to the European context, the national level, and finally, the urban and local levels. The section concludes with a discussion of the key actors in Sweden's smart electricity grid landscape.

Transition to renewable energy

The European Union's (EU) main goals for a common electricity market are to ensure competitiveness, security of supply, and the promotion of environmental sustainability (Svenska kraftnät, 2023). Reacting to the global challenges of climate change and atmospheric warming at a supranational level, the EU sets ambitious goals, such as the European Green Deal, with its comprehensive policy goals (European Commission, 2019a). The long-term goals of the EU nation-states are to meet the United Nations Paris Agreement commitments, which aim to limit the temperature increase to 1.5°C (United Nations, 2015), and to meet this goal, more renewable energy is needed.

The main benefits of renewable energy (such as solar, wind, and renewable hydro) are that they are inexhaustible and have the possibility for pollution prevention (Moroni, 2024). In 2023, the EU revised its Renewable Energy Directive (EU Directive 2023/2413) with new goals for renewable energy in the EU (European Parliament and Council, 2023). Since the revision, it aims for 2030, a minimum share of energy from renewable sources to be 42.5% of the Union's gross final consumption, up from the previous 32% target, with the aspiration to reach 45% (European Parliament and Council, 2023). It states:

> *The fact that renewable energy reduces exposure to price shocks compared to fossil fuels can give renewable energy a key role in tackling energy poverty. Renewable energy can also bring broad socioeconomic benefits, creating new jobs and fostering local industries while addressing growing domestic and global demand for renewable energy technology.*
>
> (European Parliament and Council, 2023, p. 1).

The main benefits of renewable energy (such as solar, wind, and renewable hydro) are that they are inexhaustible and have the possibility for pollution prevention (Moroni, 2024). The surge in energy prices caused by Russia's invasion of Ukraine and the effects of the COVID-19 pandemic highlighted the need to increase the use of renewable energy in the EU and accelerate energy efficiency (EU directive 2023/2413). However, the transition toward renewable energy sources places significant pressure on grid operations (Meletiou et al., 2023).

Previous research has shown how local microgrids can enhance the resilience of the main grid (Dincer & Abu-Rayash, 2020; Warsi et al., 2019). Microgrid is "a group of multiple distributed generation units and loads operating as a coordinated system, connected to the main electric grid at a single point (typically, at the distribution level), and able to function in parallel with the grid or in island mode" (Prete & Hobbs, 2016, p. 524). In Sweden, the privately owned district system operator company called E.ON tested a local microgrid in Simrishamn, a village of about 140 households. The Simrishamn microgrid used 100% renewable energy from solar and wind sources and was part of an EU-project InterFlex running between 2017-2020 (E.ON, 2017). The demonstration aimed to explore potential pathways for future smart grid development, gain insights into managing future local energy systems, and evaluate viable business models (E.ON, 2017; Månsson, 2023). The Simrishamns microgrid test is a practical example of how EU projects can be implemented in a national and local setting.

Sweden's electricity system

Sweden's electricity system is characterized by the country's geography (see picture 1), with large waterfalls in the northern parts of the country. The main sources of electricity in Sweden are hydro and nuclear (International Energy Agency, 2024). 40% of electricity production comes from hydro, and 29% comes from nuclear (in 2023) (International Energy Agency, 2024). According to the Energy Institute (2024), Sweden generated 173.1 terawatt-hours of electricity in 2023 and has had steady growth during recent years; in 2013, electricity generation in Sweden was 153.2 terawatt-hours. For comparison, the same numbers for Finland are 71.3 terawatt-hours generation in 2013 and 72.2 in 2023 (International Energy Agency, 2024).

Picture 1. Swedish national grid overview (Source: Svenska kraftnät, n.d., retrieved 5 September 2024).

The first electric networks established in Sweden were during the 1880s, primarily in urban areas and industrial facilities with a geographical range of few kilometres (Kajser, 1992). These networks operated with direct current technology using low voltages (Kajser, 1992). The technological development toward the alternating current technology in the 1890s brought significant transformations in the industry, as it allowed the voltage conversion which made electricity transmission over long distances possible (Kajser, 1992).

In 1909, a Swedish State Power Board, Vattenfall, claimed to be the world's first state-owned hydroelectric power company, was established (Kajser, 1992). Rapid exploitation of the power sources in the form of the many large waterfalls owned by the state served the national interest (Kajser, 1992). The early years were formative to the Swedish electricity system:

> *The organizational structure and legal framework of the Swedish electricity system that were shaped in the first two decades of this century have by and large remained unchanged. The system has been characterized by a distinct cleavage between local distributors on the one hand, and power producers with regional monopolies on the other. Another feature has been the mixed ownership structure, involving private, municipal, and state capital.*
>
> (Kajser, 1992, p. 439).

As Kajser (1992) notes, utilities alone cannot create the system; it also needs consumers and equipment manufacturers, who played an important role in the early years. The development of the electricity system continued with coordination help from Stockholm's Enskilda Bank, owned primarily by the Wallenberg family (see more in Kajser, 1992).

Fast forward to 1992, when Vattenfall was split into Svenska kraftnät (Svk) and Vattenfall (Svenska kraftnät, 2024). Since then, Svk, a state-owned public utility, has been the electricity transmission system operator in Sweden (Svenska kraftnät, 2024). This change aimed to transform the Swedish electricity market from regional and local monopolies to a competitive market where customers can choose the producer they want (Närings- och teknikutvecklingsverket, 1991).

Today, Svk is responsible for balancing the Swedish electricity system, and they buy support services from electricity market actors while the Swedish Energy Markets Inspectorate (Ei) oversees the functioning of the markets. Electricity trade in Sweden has been deregulated since 1996, and customers have the freedom to choose an energy supplier from a number of suppliers (Swedish Energy Markets Inspectorate, 2024). Svk owns 28% of Nord Pool, which is a marketplace focusing on pan-European power exchange. Similar counterparts of Svk are Statnett in Norway, Fingrid in Finland, and Energinet in Denmark (see picture 1). The development of the neighboring countries' systems and EU legislation make it increasingly difficult to draw the system boundaries for Sweden's electricity system (Sonnsjö, 2024).

Analyzed stakeholders

This section provides a brief background on the selected actors included in the analysis. The term stakeholder broadly refers to anyone who has an interest in the issue at hand and/or is affected by it or affects it (Collins & Ison, 2006; Polk & Knutsson, 2008). However, as Fenton et al. (2016) note, not all possible stakeholders can be included as stakeholders in all stages of the planning processes; therefore, the question then really becomes who is *not* a stakeholder. Thus, the stakeholders presented here are those who were present in the studied smart grid development cases.

The distribution grids function like smaller roads branching off the main transmission network and are managed by distribution system operators. In Sweden, around 170 distribution system operators operate as either municipally-owned energy utilities or private companies. The distribution network is a monopoly (Swedish Energy Markets Inspectorate, 2023). Among the largest distribution system operators are E.ON, Fortum, and Vattenfall, also referred to as the "big three" (Magnusson, 2016). For example, E.ON is a multinational electric utility company based in Germany, which also operates locally in Malmö, where it previously ran the municipally-owned utility Sydkraft.

The primary task of the distribution system operators is ensuring a stable and reliable grid (Verkade & Höffken, 2019). However, distribution system operators now face new challenges, particularly in planning for a more active consumer base (Ioanid & Palade, 2024). Traditionally, communication between distribution system operators and consumers was one-sided, but smart grid technology, such as smart meters, has evolved into a two-way interaction, bringing new challenges to the distribution system operators

Over the past few decades, the dynamics of the energy market have shifted toward privatization and market orientation (Magnusson, 2016). During the 1990s, many municipalities faced worsening economic conditions as they struggled with both reduced state grants and municipal tax caps (Hallgren, 1997). A major reason for municipalities selling their energy companies has been acute economic problems (Palm, 2004). When the municipalities sell their energy company, they lose control over production facilities and distribution networks, which affects their ability to remain key players in the development of the energy system (Palm, 2004). Thus, municipalities that still own their energy companies, referred to as municipally-owned energy utilities, have a stronger position in energy planning projects.

The municipalities in Sweden have a significant role to play as they represent the citizens. Sweden has 290 municipalities (Sveriges Kommuner och Regioner, SKR, n.d.), and their role is to govern at the local level and provide different services, such as urban planning and public infrastructure. The Swedish government has advocated for the regional levels' agency (Renko et al., 2022). Furthermore, Swedish municipalities are often regarded as forerunners in sustainability efforts (Krantz & Gustafsson, 2021; Rosvall et al., 2023).

Municipalities role as facilitators has been discussed in previous research (i.e., Neij & Heiskanen, 2021; Böhnke et al., 2019; Guyadeen et al., 2023). It is argued that municipalities need to develop their capacity to effectively facilitate public participation (Neij & Heiskanen, 2021). According to Böhnke et al. (2019), municipalities are increasingly strengthening their role as facilitators by enabling local actors and supporting them in achieving climate goals.

Picture 2. The Nordic-Baltic bidding zones. Source: (Swedish Energy Markets Inspectorate, 2023, retrieved 7 February 2025).

Regarding electricity markets, Sweden is divided into four bidding zones (see picture 2) or price areas that were implemented in 2011 (Energy Market Inspectorate, 2012). The rationale behind this area division was to inform the transmission system operator about the location of the bottlenecks and thus help to determine the location of future investments (Sonnsjö, 2024). Even though Sweden generally has an electricity surplus, and the nation exports a considerable amount of energy, the problems the Swedish grid is facing lie in the challenges of having electricity in the right place at the right time. Phasing out fossil fuels requires electrification, which in turn means a large increase in electricity consumption (Svenska kraftnät, 2024), and this happened especially in the fast-growing urban areas. The map (picture 2) shows the infrastructural demands regarding the balancing of the system and why bottlenecks occur; much of the electricity is produced in the North, while the large and expanding urban areas are in the Southern parts, with a growing electricity demand.

There are also other actors participating in the planning and implementation of smart grids. Hojčková et al. (2018) identified key actors in a future smart-grid scenario, including regional and national governments, distribution system operators, incumbent firms, new entrants from other sections (such as information and communications technology and the automotive industry), and prosumers. In this thesis, the focus is on the actors actively involved in local development projects, specifically the studied cases.

Throughout this research, municipalities and distribution system operators (as discussed earlier) were identified as key participants, alongside property developers, energy communities, flexibility providers, and aggregators. An interesting observation is that while the initial aim was to examine the role of citizens in these projects, fieldwork revealed their limited presence. This finding aligns with Giotitsas et al. (2022), who noted that citizens are often disengaged from smart grid development processes. However, the EU's Clean Energy for All Europeans package (European Commission, 2019b) emphasizes the importance of citizen participation and the value of energy communities in the energy transition.

This thesis recognizes energy communities (EC) as professional actors. However, in the academic literature, there is no consensus on the definition of the term energy community (Moroni, 2024; Biresselioglu et al., 2021; Bauwens et al., 2022). In addition, there are several definitions for the organization of different community energy constellations, such as renewable energy communities and citizen energy communities. Without getting lost in the definitions, it is recognized that community energy refers to energy projects by and for local people (Walker & Devine-Wright, 2008). Community energy encompasses energy projects that are initiated and managed by local people for the benefit of their community. In community energy, the concept of "community" can take the form of either a community of interest (social connection) or a community of place (geographic location) (Busch et al., 2021).

One of the case studies in this thesis focuses on local flexibility markets (LFM), which is a relatively new concept. LFMs allow flexibility resource owners to provide their services to the distribution system operator, aiding in the management of peak demand and energy production (Palm et al., 2023).

Property developers are one of the actors studied in this thesis. In the urban development projects, the property developers have considerable power as they come in with the private resources depending on their size and resources. They can be national or multinational privately-owned companies, such as Nordic Construction Company Aktiebolag, or they can be public housing companies, such as Svenska Bostäder, one of Sweden's largest housing companies owned by the City of Stockholm.

Lastly, one new actor group is the aggregators, which are also part of the wider group of intermediaries. Aggregators are commercial firms that operate in electricity markets (Langendahl et al., 2014). The role of the aggregators can change as smart grid technologies develop further (Langendahl et al., 2014).

Other actors might also exist, but since they were not present in the studied cases, they fall outside the scope of this thesis. Next, the conceptual and analytical framework developed for this thesis will be presented.

Conceptual and Analytical Framework

The thesis applies a multi-level conceptual and analytical framework combining socio-technical systems (Hughes, 1987), energy democracy (e.g., Clarke, 2017; Szulecki, 2018; van Veelen & van der Horst, 2018), and the concept of roles from social interaction research (i.e., Mead, 1934; Linton, 1936; Biddle, 1986; Wittmayer et al., 2017). Each of these concepts and frameworks provides a different lens for analyzing smart grid governance: socio-technical systems explain the structural transformation of energy systems at a macro-level; energy democracy highlights governance struggles and participation challenges; the concept of roles adds a micro-level understanding of actor agency in these developments and clarifies how actors negotiate governance roles in practice. By integrating these perspectives, this analysis develops a lens consisting of socio-technical systems and energy democracy to provide a realistic account of the different actors' roles.

Socio-technical systems framework

Complex societal problems cannot be solved without interdisciplinary research (Van Rijnsoever & Hessels, 2011), and there is a clear need for more such research in the energy field (Schmidt & Weigt, 2015). Interdisciplinary research is the combination and (partial) assimilation of elements from two or more academic disciplines that enhance each other to study a phenomenon that does not quite fit into a single discipline (Sakao & Brambila-Macias, 2018). However, despite its growth, the social dimension remains understudied (Sovacool et al., 2015), and interdisciplinary energy research has yet to reach its full potential (Schuitema & Sintov, 2017). When studying the complexity of the electric grid, there is indeed a need to combine different elements, such as the social and technical aspects, from the socio-technical systems perspective (Rotmans et al., 2001; Geels, 2004; Smith et al., 2005).

The socio-technical systems perspective can help to understand the interconnected processes of social and technical change. According to Dwyer (2011), socio-technical systems theory defines systems as inherently messy, complex, and composed of problem-solving components. It is not possible to study only the technological or the social aspects of the system in isolation; both the material and social dimensions must be considered to comprehend potential development paths (Hughes, 1983, 1986; Palm & Wihlborg, 2006). The goal is not to prioritize one over the other either, even though this might be challenging in practice due to competition around different priorities.

Socio-technical systems perspectives highlight the intertwined nature of society and technology, relying on system-based methodologies to analyze these relationships. Any changes to one part of the system must account for their impact on other components to maintain the system's overall functionality (Palm et al., 2023). In systems theories, the systems often have boundaries that determine where the system ends and what is included in it; these can be physical, conceptual, or functional boundaries. The electricity grid is a complex socio-technical system, which has historically had clearer boundaries, for example, within the national borders of Sweden, but is becoming ever more complex with the smart grid technology.

With the smart electricity grid development, the construction of the electricity or flexibility markets is also gaining more complexity, as discussed in Paper II (see Palm et al., 2023). The marketplaces also exemplify socio-technical systems, wherein technical and social components interact to form a unified system. Applying the socio-technical systems perspective to the local smart grid projects as well as in the marketplaces, it acknowledges that the actors possess agency, yet they operate within structures that influence their preferences, shape their goals, and guide their strategies (Geels, 2004; Thollander et al., 2010). The actors influence these systems through their actions while simultaneously reshaping them (Geels, 2004; Giddens, 1984).

The socio-material configurations can take different forms depending on actor coalitions and local geography (Skjølsvold & Ryghaug, 2015). "The landscape is an external structure or context for interactions of actors" (Geels, 2002, p. 1260). It includes people, roles, relationships, skills, culture, and organizational structures. Technical systems are shaped by their interactions with their surroundings and influenced by a range of external factors, including geographic, political, economic, social, legal, cultural, and historical conditions (Palm & Wihlborg, 2006).

In this thesis, the socio-technical systems provide the macro-level perspective, explaining how technological systems, institutional structures, and social practices co-evolve. It helps contextualize smart grids as part of an ongoing energy transition where new technologies, regulatory frameworks, and actor interactions shape system change.

Energy democracy perspective

In this thesis, the energy democracy perspective serves as a bridge between governance and participation. The energy democracy framework (e.g., Szulecki, 2018; Stephens, 2019) builds upon socio-technical systems theory, particularly by emphasizing who participates in decision-making within local smart grid projects. While socio-technical systems describe systemic shifts, energy democracy focuses on power dynamics, inclusion, and citizen engagement in energy governance (Feldpausch-Parker & Endres, 2022; van Veelen & van der Horst, 2018). However, the energy democracy research has largely overlooked the question of whether energy democracy occurs at the local, regional, or national level or across all three (Busch et al., 2023).

As an emerging research field (Feldpausch-Parker & Endres, 2022), energy democracy is still evolving conceptually and methodologically. Key themes in energy democracy research include questions of who controls energy production and consumption (Stephens, 2019), the role of collective prosumerism and cooperatives in democratizing energy systems (Wahlund & Palm, 2022), the transition from passive consumers to active participants (McKasy & Yeo, 2021), and amplifying citizen voices in energy governance (Clarke, 2017). This redistribution of power reframes citizens as active stakeholders rather than mere energy consumers,

The concept of energy democracy has its roots in social movements, activism, and non-governmental organizations, particularly in the United States, advocating for greater public participation in energy decision-making (Feldpausch-Parker & Endres, 2022; van Veelen & van der Horst, 2018). These social movements emerged to challenge the dominance of large energy companies (Busch et al., 2023). However, no single, universally accepted definition exists (van Veelen & van der Horst, 2018).

Feldpausch-Parker et al. (2019) identified three analytical dimensions of energy democracy: justice, participation, and power. They argue: “By focusing on this nexus, research on energy democracy has the potential to produce results that are directly relevant to the pressing issues faced by contemporary energy practitioners and policymakers.” (Feldpausch-Parker et al., 2019, p. 3). This thesis does not focus on the justice aspects of energy democracy but acknowledges their importance and the need for further research in this area. While justice considerations are a crucial part of the broader picture, they fall outside the scope of this study.

Furthermore, Feldpausch-Parker and Endres (2022) note that composing (Latour, 2010), the practice of combining elements such as energy and democracy is a complex task. I agree. While I provided definitions of energy at the beginning of this thesis, I will now focus explicitly on democracy. In this context, I find Fung’s

(2006) pragmatic perspective on urban democracy particularly useful and potentially beneficial for the further conceptual development of energy democracy.

Fung (2006) emphasizes that a key feature of any public decision-making mechanism is determining who is eligible to participate and how individuals gain access to participation. Equally critical is accountability to those who do not actively participate (Fung, 2006), who, in the studied cases of smart grid development in this thesis, largely refer to citizens. Even though smart grids require social acceptance (Skjølsvold et al., 2015), and citizens have an important role in the energy transition, they are often disengaged from the process, and many questions remain about how their inclusion will be implemented in practice (Renström, 2019; Giotitsas et al., 2022). Furthermore, previous research highlights how marginalized groups of citizens are frequently underrepresented (White, 1996; Parvin, 2018) or deliberately excluded (Dekker & Van Kempen, 2009; Monno & Khakee, 2012). In summary, regarding power, the question of who takes part is critical (Fung, 2006; Cornwall, 2008).

On a final note, like socio-technical systems research, energy democracy carries inherent normative assumptions, for instance, that participatory governance is inherently beneficial, and that increasing citizen involvement somehow improves the system. While energy democracy and socio-technical systems research often emphasize the importance of public participation, some critics argue that a centralized energy system may be more efficient and question whether increased citizen involvement truly enhances energy governance. As argued throughout this thesis, citizens are already participants in smart grid development, whether their role is visible or invisible in the projects. From a socio-technical systems perspective, the social and technical aspects of energy systems cannot be separated. Thus, in my view, the critical question is not whether citizens should or should not be involved but rather focus on how democratically the system is governed and who gets to decide on participation mechanisms.

This thesis primarily focuses on indirect participation and its implications for the development of Sweden's local smart electricity grid projects. The value of the energy democracy framework in this context lies in its ability to highlight how the transformation impacts diverse professional actors engaged in the development of smart grid at the local level. To analyze this further at the local level, a more tangible concept is needed, and this is where the concept of roles comes into play.

Previous research by Williams and Sovacool (2020) examined energy democracy as a framing strategy in the UK parliamentary debate on shale gas. It showed that while local community participation and control over decision-making influenced government and industry to some degree, its impact was limited by broader priorities like industrial strategy and economic development, making it a less effective framework in national politics (Williams & Sovacool, 2020).

The concept of roles

The concept of roles adds understanding at the micro-level. By analyzing actors' agency in local energy governance, the concept of roles from the field is helpful in examining how actors negotiate their positions within transitions. While socio-technical systems and energy democracy describe broad structural and governance shifts, the concept of roles from social interaction research allows for an in-depth analysis of how professional actors perceive and contest emerging roles in the smart electricity grid. It helps to analyze how roles evolve and change in transition processes.

Wittmayer et al. (2017) focus on the multi-actor nature of transitions, where changes in the roles of actors and their relations with others are recognized as an important part of any transition. Wittmayer et al. (2017) argue that the concept of roles can be used as a governance tool, and policymakers can create, assign, or dissolve different roles to manage transitions. They propose that the concept would be applied to the multi-level perspective, which focuses largely on niches, regimes, and landscapes while putting less focus on the actors and agency (Wittmayer et al., 2017). The concept of roles originates from, for example, Mead (1934) and Linton (1936) and was later developed by Biddle (1986).

Role theory has evolved within sociological frameworks that emphasize how individuals' experiences are shaped by broader social institutions (Biddle, 1986). Role theory recognizes that persons are members of social positions and hold expectations for their behaviors and those of other persons (Biddle, 1986). “As the term role suggests, the theory began life as a theatrical metaphor” Biddle notes (p. 68). This further means that there are scripts in certain situations, leading to a triad of concepts within the theory: patterned and characteristic social behaviors, parts of identities that social participants assume, and scripts or expectations of behavior that are understood by performers (Biddle, 1986). “It concerns one of the most important characteristics of social behavior, the fact that human beings behave in ways that are different and predictable depending on their respective social identities and the situation.” (Biddle, 1986, p. 68). The research that has applied role theory has focused largely on role conflicts, role-taking, role-playing, and consensus (Biddle, 1986).

As Wittmayer et al. (2017) note, it would also be interesting to study contexts where the actor roles do not change or where the role change proves difficult. For example, Lazoroska (2023) studied the role of women in solar energy communities in Japan and how women navigate the energy landscape, their evolving social positions, and their agency within it.

Wittmayer et al. (2017) note that it is possible to study single roles or role constellations at a specific point in time or over time, focusing on how things change. In the multiple-case study of this thesis, the object of study is actor constellations, the roles that interact and co-evolve with one another (Wittmayer et al., 2017). The relations between the different actors and their roles are of interest here, across the cases.

The role theory can help to analyze how different actor constellations evolve. As this thesis aims to explore the changing and emerging roles of both new and existing actors, the concept of roles fits well. Through the socio-technical perspective and the concept of roles, the thesis advances in analyzing the actors, networks, and stakeholders and their changing relationships and the empowerment of new actors. While the study does not focus on the distinct phases of socio-technical transitions, such as emergence, growth, or maturity of the system, it instead emphasizes the energy transition in terms of its implications for different actors and the relationships between them, making the socio-technical systems perspective and the concept of roles, particularly relevant.

This chapter has discussed the conceptual and analytical framework developed for this thesis consisting of socio-technical systems (Hughes, 1983), energy democracy (e.g., Clarke, 2017; Szulecki, 2018; van Veelen & van der Horst, 2018), and the concept of roles. Together, these concepts and frameworks provide an analytical tool for multi-level analysis of smart grid governance, how smart grids are governed, who participates, and why governance conflicts emerge. A combination of these frameworks and concepts was needed to address the aim and research questions better. Next, the material and methods will be presented.

Material and methods

This chapter situates the research within relevant scientific paradigms and outlines the methodology of this thesis. It begins by presenting the scientific positioning, addresses reliability and validity, presents the research design, followed by data gathering and data analysis, ethical considerations, and ends with a discussion on limitations.

Scientific research positioning

This thesis is positioned in the field of qualitative energy social science research. Within energy social science research, as in many other fields, there are several differing paradigms, such as positivism, interpretivism, and critical realism, which have different ontological, epistemological, and methodological positions (Sovacool et al., 2018). Ontology deals with the question of what the nature of reality is and what can be known about it (Guba & Lincoln, 1994) or, in social research, more specifically, whether the social world is regarded as "something external to social actors or as something that people are in the process of fashioning" (Bryman, 2012, p. 19). Epistemology, on the other hand, deals with questions about "what is regarded as appropriate knowledge about the social world" (Bryman, 2012, p. 19). The methodological choices in social research are connected to the discussions of how the social world should be studied (Bryman, 2012).

Regarding ontology, this thesis adopts a critical realism (Bhaskar, 1975) position, where the emphasis lies methodologically on depth rather than generalizability as in positivism, and it is agreed that one objective reality exists. However, as Hammersley and Atkinson (2007) suggest, researchers could also take a more subtle realism position, meaning that there is a social reality out there, but we partly create this as researchers. In keeping with the critical realism position, the thesis positions itself more precisely with what is known as subtle realism (Hammersley & Atkinson, 2007). Subtle realism means that while there indeed is a social reality out there, we as researchers partly construct the data we are studying through certain methodological choices and views (Hammersley & Atkinson, 2007). In this sense, social researchers are part of the social world they study and should never forget that (Hammersley & Atkinson, 2007). This ontological position for my research implies that during my research process, I have reflected upon how the choice of the methods and theories used influence the research process and, eventually, the findings.

As a researcher embedded in the study of smart grid governance, my role was not purely observational but also interpretative. Following the subtle realism approach (Hammersley & Atkinson, 2007), I acknowledge that while an objective reality exists, my methodological choices, interactions with participants, and interpretation of qualitative data inevitably shaped the findings. During participant observations, my presence may have influenced discussions, particularly when stakeholders perceived my research as aligned with certain policy perspectives. Likewise, during interviews, the way questions were framed affected their responses. To mitigate these biases, I employed triangulation across data sources (interviews, documents, observations), included and analyzed data gathered by other researchers than myself, and conducted peer debriefing after the interviews and observations to ensure that findings remained grounded in empirical evidence rather than personal interpretations.

This thesis is a product of interdisciplinary research, integrating concepts, methods, and theories from multiple disciplines to advance understanding and address challenges that extend beyond the scope of a single field (National Academy of Sciences, National Academy of Engineering & Institute of Medicine, 2005) such as the climate change. Given this interdisciplinary nature, the subtle realism perspective (Hammersley & Atkinson, 2007) is particularly well-suited, as it acknowledges that while an objective reality exists, knowledge is inevitably shaped by the researcher’s interactions, methods, and interpretations. This perspective allows for a nuanced engagement with empirical data, recognizing the complexity of governance, actor roles, and energy transitions while maintaining analytical rigor.

Validity and reliability

Robust research design must consider several aspects, such as validity, reliability, and other aspects, such as objectivity, generalizability, and ethics (Bryman, 2012). Ethics will be discussed further, but here, validity and reliability are addressed. Validity (internal and external) means whether the research or findings are correct (Bryman & Bell, 2015). In this research, validity was ensured by combining secondary data sources with primary data, which enhances the validity of findings by enabling data triangulation (Creswell & Creswell, 2018), which means that the findings are confirmed with data from at least three different sources support or at least do not contradict it (Miles et al., 2014).

Reliability means whether the research could be conducted by other researchers (Kvale & Brinkmann, 2009), and in this thesis, it was ensured by presenting detailed descriptions of the used methods and by being as explicit and self-aware about personal assumptions as possible (Miles et al., 2014). Furthermore, for quality and integrity, when conducting fieldwork, the researcher's role as a researcher has been explicitly described for the informants, and later when conducting data analysis, forms of peer or colleague review have been used (Miles et al., 2014). Finally, to ensure quality, descriptions were designed to be as detailed, meaningful, and context-rich as possible (Geertz, 2009). For me, this was made possible by including practices such as repeated field visits, as in the case of Sege Park, writing detailed field notes to facilitate later reflection on specific aspects, and taking photographs to document key observations, to name a few.

Moreover, all the Papers in this thesis are co-authored, which may lead to better quality by harnessing the experiences and inquiries of several researchers. The process can be more creative and innovative. However, co-authoring Papers was time-consuming and required more coordination than a single-authored process.

Case study approach

This thesis is designed around a qualitative case study approach (Yin, 2009), around five local "bounded" (Stake, 2003, p. 135) cases reflecting the diverse pathways in Sweden's smart grid development. These five cases were chosen because they represent different pathways in the smart grid development in Sweden and bring nuanced insights into the actor constellations and the barriers and drivers the actors face in the local energy planning projects. The case study method is well-suited and robust because it enables me to understand the wider processes of smart grid development and foster a deeper understanding of it by providing a comprehensive perspective of the local conditions (Sahlin-Andersson, 1986).

The selection and definition of cases is a critical component of a case study research. In this thesis, the cases were pre-existing and not constructed (Ragin & Becker (1992), and they were primarily selected based on accessibility, which is a key consideration (Stake, 1995). Without access, fieldwork and data gathering is not possible. In this thesis, the selection process followed a bottom-up approach, where cases were identified by observing real-world processes as they unfolded.

Even though case studies are often criticized for their limited generalizability, they provide a foundation for theoretical generalization (Yin, 2009). The findings from the five cases examined in this thesis can be applied to other contexts, such as different countries or regions, as they may resonate with similar but unstudied contexts (Hay, 2016). By conducting a multiple-case study (Yin, 2009), I strengthened theory building (Bryman, 2012).

Case descriptions

This thesis examines five case studies representing different dimensions of smart grid development: two urban smart grid projects (Cases 1 and 2), two energy community (EC) initiatives (Cases 3 and 4), and a local flexibility market (LFM) demonstration project (Case 5). Each case contributes unique insights into the evolving role of professional actors in smart grid development.

Urban Smart grid Projects (Cases 1 and 2)

The two urban development projects illustrate smart grid development in an urban context, which is crucial as cities serve as key experimentation sites (Palm & Bocken, 2021; Voytenko et al., 2016). Both projects have high sustainability ambitions and involve several stakeholders.

The first urban development project is located in Southern Sweden. This project has been going on for a long time, starting in 2006, and is planned to be ready in 2050, which reflects its scale. This flagship project is divided into different subareas, parts of which have already been finished. The municipality plays an important role in this project by acting as a planning authority, major landowner, co-owner of the distribution system operator (enabling the management of the district heating, electricity grids, energy production facilities, and fiber optic networks and the owner of the municipal housing company. In this case, in contrast to the second urban development project, the distribution system operator is owned by the municipality, also known as a municipally owned energy utility.

In this case, the data was gathered using interviews, participant observations, and document studies. I did not participate in the primary data gathering in this case, but I engaged in document studies for background information. Interviews, three in total, took place on Teams, where the first two interviews were recorded, and under the third, the researcher took notes. The interviews took place in 2021 and 2022 with municipal representatives, including environmental planners and project managers. Participant observations included two site visits and four workshops involving municipal planners, energy strategists, and representatives from the municipal housing company, energy company, and property developers. The interviews and municipality-organized workshops focused on strategic decisions related to energy system design and potential collaboration opportunities. Document studies, in this case, involved analyzing municipal plans, promotional materials, and technical reports.

In the other urban development project, the municipality is redeveloping an old district. The idea is to develop the area into an urban space with a mix of housing, business, public services, and public parks. According to the plans, by 2025, there will be over 1000 dwellings. The development process of this, likewise case 1, a flagship urban area, has a sustainable approach with a specific focus on a low-carbon, climate-smart district, and testbed for different sharing solutions. There have been 12 property developers involved in the building process, the local distribution system operator, and the water and sewage company. The municipality used the dialogue planning model with the property developers. Property developers are a heterogeneous group, ranging from major national property developers to private individuals who are building collective houses.

In case 2, the data was gathered using semi-structured interviews, participant observations in planning meetings, and document studies. A total of 27 interviews were conducted with property developers and municipal representatives at two different stages of the planning process: the first round in 2019 and the second in 2022. Throughout the planning phase, the municipality and property developers held 47 meetings, with participant observations conducted in 32 of them. For the remaining 15 meetings in which we were not physically present, memory notes and relevant documents were collected. Observations took place both onsite and online via Teams, spanning the period from 2017 to 2023. Document studies, in this case, involved analyzing municipal documents.

Energy Community Cases (Cases 3 and 4)

The two energy community cases represent collective energy initiatives that explore the governance, ownership, and participation structures within local renewable energy projects. These cases were selected based on accessibility and their potential to reveal how community-driven projects interact with existing energy governance frameworks.

Case 3 (EC1 in Paper IV) is an energy community in Southern Sweden. The community has 763 members (in February 2025) and uses solar energy as the energy source. According to the statutes, the association aims to advance its members' financial interests by generating solar energy while also helping members enhance their environmental credentials and potentially benefit from profit distribution. Members contribute to the association through their labor and by promoting awareness of solar energy and the association's initiatives, as noted in the statutes. We conducted the first round of interviews in 2021 and the second round in 2022. In total, seven interviews were conducted with four different respondents. We also engaged in participant observations during their annual meeting in 2022. Desk research included minutes from previous annual meetings.

Case 4 (EC2 in Paper IV) in the thesis is an energy community in Sweden. It was established in 2009 to promote solar energy and show that it could be used on a larger scale. The association's original goal was to show that solar energy is a viable option, and this has been rather successful. However, in 2024, after the data was gathered for Paper IV, the local energy company took over the solar energy installations previously owned by the association. This means that the members of the association are no longer responsible for solar energy production and its maintenance. Even though the association does not own the plants anymore, it will continue to exist, but its role will change to focus more on energy storage.

Due to its smaller size, two key informants who were involved at the initiation of the EC and were still active in it were interviewed in 2018 and 2023. I did not participate in the data gathering in this case. Desk research included statutes and minutes from previous annual meetings.

Local Flexibility Market Demonstration (Case 5)

The LFM case was chosen to examine an emerging aspect of smart grid development, market-driven flexibility services. This case introduces actors not represented in the other four cases, such as flexibility aggregators, who may play a crucial role in the future smart energy system.

Case number five is the local flexibility markets (LFM) testbed called CoordiNet, a Horizon 2020 demonstration project focusing on how transmission system operators, distribution system operators, and consumers could collaborate and coordinate to provide flexibility services to the electricity grid (Palm et al., 2023). The CoordiNet case includes both CoordiNet Uppland, which includes the counties of Uppsala, Stockholm, Södermanland, and Västmanland, and CoordiNet Skåne, which covers the county of Scania. The project ran from January 2019 to June 2022. Twenty-five qualitative in-depth interviews were carried out in organizations participating as flexibility service providers, and organizations that had decided not to participate were referred to in the Paper as potential flexibility service providers. The interviews took place in Zoom/Teams and were recorded and transcribed. I conducted interviews together with another colleague in 2021 and in 2022 on my own. Colleagues from Uppsala University conducted more interviews in CoordiNet Uppland, and I continued gathering data in CoordiNet Skåne with another researcher.

These five cases complement each other by analyzing different pathways in Sweden's smart grid development. The next section outlines the data collection methods.

	Case 1	Case 2	Case 3	Case 4	Case 5
Type of case	Urban Smart Grid Project	Urban Smart Grid Project	Energy Community	Energy Community	Local Flexiblity Market
Status	Ongoing, planned to be ready 2050	Ongoing, planned to be ready	Ongoing	Ongoing	Not active
Geographical focus	Limited local city district	Limited local city district	Members distributed	Members distributed	Local sites: Uppland and Skåne
Key actors involved	- Municipality - MEU	- Municipality - DSO - Developers	Members	Members	- TSO - DSOs - Flexibility service providers - Aggregators
Interviewed actors	Representatives from municipality: - Environmental planners - Project managers	- Representatives from municipality - All the included 12 property developers	- Representatives from the EC	- Representatives from the EC	Flexibility service providers and potential flexibility service providers: - Industry - Energy storage - Building owners- Heat producers - Renewable power producers - Transportation providers Aggregators
Citizen representation	Indirect	Indirect	Direct	Direct	Not included
Data gathering methods	3 interviews in 2021 and 2022 Participant observations in 2021 and 2022 Document studies	27 interviews in 2019 and 2022 Participant observations during 2017-2023 Document studies	7 interviews in 2021 and 2022 Participant observations during 2022 Document studies	2 interviews in 2018 and 2023 Document studies	25 interviews in 2021 and 2022 Observations in 2021 Document studies
Included documents	Municipal plans Advertising materials Technical reports	Municipal plans Reports	Minutes from previous annual meetings	Statutes, minutes from previous annual meetings	Advertising materials
Author's role in data gathering	Document studies	Interviews, observations & document studies	Interviews, document studies	No role in data gathering	Interviews, observations & document studies

Table 3. Overview of the five empirical cases.

Data gathering

The data used in this thesis was collected through the methods of document studies, interviews, and participant observations described below. See Table 2 for an overview. Gathering data from documents is sometimes called ‘desk research’ while the practice of gathering data by interviewing and observing is commonly known as ‘fieldwork’: “[…] the term used in qualitative research to cover the data-collection phase when the investigators leave their desks and go out ‘into the field’” (Delamont, 2003, p. 206). The field is a metaphor for a setting or population (Delamont, 2003), just as the desk is a metaphor for secondary data gathering.

My approach to data gathering was shaped by both my academic training in ethnography and prior research experience with qualitative data gathering. Additionally, my limited prior experience in energy and technology also shaped my approach. Initially, I viewed my inexperience as a limitation, but I learned to use it as an advantage and started deliberately asking informants to explain the basic aspects of their practices. As a young female, I was well suited for this role even though it caused me internal frustrations and concerns about reinforcing existing stereotypes. Nonetheless, being an ‘outsider’ also, in the sense of a foreigner studying the Swedish energy system, further provided me insights and critical distance into how stakeholders articulated their perspectives and roles, which was my aim.

Document studies

Document studies align with what Wolcott (1999) refers to as 'examining'. He means the process of critically analyzing and interpreting existing materials. The documents analyzed in the cases 1-5 thesis were official documents in the form of municipal documents that were selected based on their relevance to the case. When selecting documents, Scott (1990) suggests four criteria: authenticity, credibility, representativeness, and meaning. According to Bryman (2012), when analyzing official documents, the question regarding credibility raises the issue of whether the documentary source is biased. Thus, the researcher needs to stay critical of the context and sources of the documents.

Additionally, in Paper I, a semi-structured literature review was conducted, and data was gathered using the online search engines Web of Science and Scopus with the search term: “smart grid” resulting in 1 352 hits in total. After removing duplicates, 1140 hits remained. After excluding three articles due to paywall, the selection criteria were used in all the articles, resulting in 304 relevant articles (see more details in Paper I). After examining the full-text versions of these articles, 111 articles were left, which were analyzed in-depth and included in the analysis. This method has its limitations, mainly in the task of finding the exclusion/inclusion balance, which involves a considerable iteration process.

Interviews

Interviews correspond to what Wolcott (1999) describes as 'enquiring', where the researcher asks the informants questions to gain insights (i.e., conducting interviews or structured conversations). Most of the cases used the semi-structured interview method. I used an interview guide prepared in advance for all the interviews I conducted. Even though the interview guides used in different cases were somewhat different, they were similar enough to compare the data. Almost all the interviews were recorded and transcribed, with few exceptions where notes were taken instead. I transcribed many of the interviews I conducted, which was a fruitful way to learn to know the material and start the analysis, but some of them were transcribed by someone else. I conducted interviews mainly alone but sometimes also with other researchers.

Interviews were conducted for Papers II–V, with a total of 64 interviews completed. I conducted interviews during 2019-2023. Other researchers conducted some of the interviews, but semi-structured interview guides were used for all interviews, with themes varying depending on the study's focus. However, the overall approach remained consistent across the cases. For example, in case 5, the research followed a structured interview approach, with minor modifications based on whether the organization was a flexibility service provider or a potential one. By using in-depth interviews, the interviewees were able to explain why and how a factor was seen as a driver or barrier (Kvale & Brinkmann, 2009; Roulston, 2010).

The informants were selected based on their role in the planning processes, in the local flexibility markets, and access. They were primarily property developers, municipal representatives, energy community members, distribution system operators, and flexibility service providers in Sweden. Access to these actors was fortunately possible, and their willingness to contribute their time made this thesis achievable.

Participant observations

By employing participant observation, I was able to ‘experience’ (Wolcott, 1999) firsthand the dynamics among stakeholders involved in the local energy planning projects. By immersing in the field, the researcher can understand how the cultures they are studying ‘work’ by observing, recording or documenting, and reflecting on their own experiences (Delamont, 2003). Participant observation allows the researcher to engage directly with members of a social group within their natural environments, capturing implicit interactions and even uncovering unexpected topics or issues (Bryman, 2012).

At the same time, my presence as an observer may have influenced the observed interactions. This became evident both during fieldwork and in later reflections, particularly when viewed through the lens of subtle realism (Hammersley & Atkinson, 2007), which acknowledges the researcher’s role in constructing knowledge rather than merely documenting an objective reality. In addition, as an observer, I recognize that my focus might land on certain aspects that another researcher might interpret differently, and vice versa.

Papers II–V used the participant observation method. In Case 2, I conducted on-site participant observations between 2020 and 2023. In Case 5, I also attended several online webinars on flexibility markets in 2021. While the data from these webinars was not included in Paper II, it served as background knowledge that informed the broader analysis in this thesis.

Qualitative data analysis

My approach to qualitative data analysis was shaped by my academic training in social anthropology and urban studies and prior research experience. My familiarity with theories around smart cities and urban democracy influenced how I interpreted stakeholder interactions in local energy planning projects. At the same time, my limited prior experience in the field of energy technology also shaped my analytical perspective.

In practice, this meant that I noticed my focus naturally gravitated toward the cultural and social dynamics in the planning processes rather than the technical aspects of the system. During the research project, I was mostly interested in the culture around energy planning and how it is shaped and reshaped. However, throughout my PhD, I made a deliberate and consistent effort to develop an understanding of technical terminology and system functionalities to ensure a more comprehensive engagement with the field.

Due to the different aims, approaches, and designs of Papers I-V, the thesis applied a few similar qualitative data analysis methods. These were conducted inspired by thematic analysis and reanalysis (Wästerfors et al., 2014). The approach throughout the Papers was bottom-up, meaning that the concepts and categories emerged from the data that suited the thesis's aims. I will give a brief overview of the data analysis process here, but more details can be found in the individual Papers.

Paper I, a semi-structured literature review, had an exploratory approach, where concepts and themes disciplines were allowed to rise from the data (Sovacool et al., 2018). When rearranging the data this way, certain narratives were teased out (Kojonsaari & Palm, 2023). This was a very interesting way to review the material, and the analysis had already started as I was collecting the data and applying the exclusion criteria. Certain themes started to emerge as I went through all the abstracts of the many hits. The data was managed in an Excel file for the literature review.

In Paper II, the interview data with the potential and existing flexibility service providers was recorded, and the transcripts were coded in qualitative data analysis software Nvivo with a standard coding scheme developed for the study (Palm et al., 2023). Each interview, lasting about an hour, was conducted online by one or two researchers, recorded with the participant's consent, transcribed word-for-word, and analyzed with a predefined coding framework. For the purposes of ensuring confidentiality, interviews were assigned coded letters. We developed the coding scheme together with the co-authors, who had also gathered data. This was a very fruitful way to collaborate and also ensured a way to avoid personal biases and, in this way, increase the validity of the findings. The coding scheme was categorized into barriers and drivers, and the categories rose from the data.

In Paper III, the case study of Sege Park, the data gathered through participant observations, interviews, and document studies was analysed with a developed analytical framework around two discourses (Kojonsaari & Palm, 2021). While the Paper discusses different discourses, it is not a discourse analysis per se. Here, as well, the data analysis was a messy process, where we went back and forth with the data and the analytical framework.

Paper IV is a continuation of Paper III, a case study of Sege Park, with a different theoretical framework around windows of opportunity and a focus on timing in the planning process. Again, the concepts emerged from the data in the coding process, which were allowed to lead the analysis. In this case, the analysis comes close to a longitudinal study, which allows for theory building (Bryman, 2012).

In Paper V, the multiple-case study method (Yin, 2009) was used. Having multiple cases in the analysis improves theory building (Bryman, 2012). The data was analyzed in the form of a reanalysis (Wästerfors et al., 2014), meaning that it had been gathered prior to the study. Reanalysis should be at the core of qualitative research because it has the benefit of being able to develop new insights that are not yet studied by comparing data and framing it in new ways (Wästerfors et al., 2014). Due to these reasons, the reanalysis of data was deemed especially relevant and useful in Paper V, where the data was gathered not only by me but also by other researchers, which made it possible to explore new aspects and draw an analysis across the cases. While the data collection methods varied slightly across the cases, the overarching objectives of the single cases were consistent, allowing an overall analysis across cases. The tradition of writing several insights and findings based on previously conducted fieldwork is common in the field of anthropology (Wästerfors et al., 2014) and, in this sense, fits well also in interdisciplinary research, drawing from social anthropology among other disciplines.

Aspects that need to be considered and that can be challenging when conducting a reanalysis are the context of the gathered data, which can be (partially) unknown, the role of the researcher's invested emotions, and not least, the research subjects and community's rights (Wästerfors et al., 2014). Wästerfors et al. (2014)

recommend that future research include the possibility of reanalysis of data in the informant consent, which is needed if the new research questions are not considered to be close enough to the original project so that the primary consent is sufficient and storing and marking of data carefully.

Ethical considerations

Research should be conducted in accordance with ethical principles and considerations to prevent causing harm (Miles et al., 2014). In this thesis, the ethical concerns are mainly focused on fieldwork and data gathering. As well known, good research practices include basic normative ethics, risks, and impact on research actors, privacy and personal data, data management, GDPR, and ethical review. Diener and Crandall (1978) categorized the ethical principles into four categories: possible harm to participants, lack of uninformed consent, invasion of privacy, and deception. All four principles were considered prior to the data gathering.

Oral consent was obtained at the beginning of every interview. The informant was informed about the aim of the project and reminded that participation in the study was voluntary. Even though no sensitive information was asked from the informants, they were informed that they had the right to refuse to answer the questions they did not wish to answer. They were also informed that the data from the interviews could be published in a research article in a way that would ensure that their names were not revealed but would be anonymized. In each published article, the level of privacy has been the highest possible.

Additionally, the informants received contact details for the researcher and the supervisor of the PhD student, whom they could contact if they wished so. All informants gave oral consent and were also offered the possibility to edit the interview transcriptions. Regarding the storage of the interview data, the research follows Lund University's data policy.

Key findings

This thesis explores the three research questions formulated at the beginning of this thesis by analysing five case studies that represent different dimensions of Sweden's smart grid development: two urban smart grid projects (Cases 1 and 2), two energy community (EC) initiatives (Cases 3 and 4), and a local flexibility market (LFM) demonstration project (Case 5). Each case provides unique insights into the evolving roles of professional actors in the smart grid transition. This section presents the empirical findings from the five cases, structured around three key themes following the logic of the research questions: (1) the roles of professional actors in local energy planning, (2) barriers and drivers shaping participation, and (3) implications for democratic energy governance. These themes align with the research questions and provide insights into the governance challenges of local smart grid projects in Sweden.

However, I will first briefly present the findings from Paper I, the literature review on social science studies focusing on smart grids up to May 2022. The findings indicate that research on smart grids has largely been shaped by socio-technical imaginaries, human-technology relationships, and social practice theory, particularly in the early conceptual phases (Kojonsaari & Palm, 2023). As demonstrations and testbeds began to emerge, studies gradually shifted towards analyzing how different actors engage with these technologies. The introduction of smart meters, for example, enabled active consumer participation in electricity management and made material participation an important research focus. Furthermore, governance theories have become more prevalent as smart grids materialize further.

Finally, the paper identified gaps in the research field regarding the democratic aspects of social science studies focusing on smart grids. In summary, six key research gaps were identified, emphasizing the need for clearer definitions, inclusion of diverse actors and geographies, more focus on energy democracy, and critical engagement with the centralization-decentralization nexus. See more in Kojonsaari and Palm (2023). This overview of the state of the art until May 2022, based on the findings from Paper I, highlights the need to examine the included actors, their roles in smart grid planning and implementation, and the implications of their evolving roles from a democratic energy governance perspective.

Actor roles in local energy planning

This section presents the findings related to the first research question: Which professional actors are involved in the studied local energy planning and local flexibility markets? This question helps identify the actor constellations that were engaged in local smart grid projects in Sweden and their perspectives on actor configurations within local energy planning initiatives. The findings presented here are based on the five studied cases:

- Urban Smart Grid Projects: Cases 1 and 2
- Energy Communities: Cases 3 and 4
- Local Flexibility Market: Case 5.

As discussed earlier, Wittmayer et al. (2017) called for studies on negotiation processes between collective actors and their broader environment. This research aims to address that call. The actors involved in the planning of the studied local smart grid cases in Sweden primarily consist of expert groups. More specifically, the actor constellations in these cases include municipalities, distribution system operators, municipally owned energy utilities, property developers, energy communities, aggregators, and flexibility service providers.

Wittmayer et al. (2017) note that role constellations can be studied at a single point in time or over time, focusing on how they evolve. In the multiple-case study of this thesis, the object of study is actor constellations—the roles that interact and co-evolve with one another (Wittmayer et al., 2017). The relationships between different actors and their roles are examined across cases. Wittmayer et al. (2017) propose guiding questions for analyzing role constellations in transition, depending on whether the focus is on a specific moment in time or changes over time. When the object of analysis is a single point in time, the guiding questions are:

- What is the role constellation about?
- Which roles are part of it?
- How are the relationships and interactions between the roles described?
- What is considered problematic (or desirable) about the role constellation?

When the object of study is change over time, the guiding question is: How did role constellations evolve between two distinct points in time? The questions above guided the analysis but were not followed rigidly.

Here, I will examine the actor constellations case by case, exploring how actors perceive their roles and identifying potential role conflicts arising from differing perceptions of each other's roles within specific projects.

Urban smart grid projects

In urban smart grid projects, the municipality plays an important role as a facilitator and coordinator. The municipality actively facilitates collaboration among other key stakeholders, such as the distribution system operator, property developers, and municipal actors, to explore new energy solutions. The municipalities in the studied cases acted as facilitators and coordinators in smart grid planning, though their authority varied.

In case 1, the municipality's role was dominant, as it was the planning authority, landowner, and owner of the distribution system operator and municipal housing company. By doubling in all these roles, the municipality was able to exercise quite a lot of power and steer the main energy-related decisions, including innovations in energy sharing and microgrids.

In this case, ambitious sustainability strategies were operationalized through, for example, a research platform for innovations in energy system solutions. A dedicated unit within the planning organization focused on innovation and sustainability. The municipality, together with the distribution system operator and the municipal housing company, had an active role in organizing meetings and workshops about energy with the contractors (Palm et al., 2025).

In this case, the municipally owned energy utility allowed for integrated decision-making across different infrastructures, including district heating and fiber-optic systems.

In case 2, the observed role constellation included the municipality, the distribution system operator, and the property developers. The municipality had sold its energy system to the distribution system operator and, in doing so, also sold its control over energy-related issues. Previously, the municipality owned the energy company, but now it needs to operate differently by connecting property developers with the distribution system operator and, in this way, facilitating the cooperation process (Kojonsaari & Palm, 2021). In this case, the municipality's role is to act as a facilitator. However, the municipality's facilitating role was not clear to all property developers. In fact, some of the property developers wished that the municipality had taken a more leading role with greater control over the process.

On the other hand, some property developers viewed the distribution system operator 's powerful role as problematic and expressed concerns about role conflicts. Several property developers found it unusual that the distribution system operator was given *a lot of latitude* (see Kojonsaari & Palm, 2021). They argued that the distribution system operator took the lead in setting the agenda, which conflicted with how property developers had perceived the distribution system operator 's role (see more in Kojonsaari & Palm, 2021).

The interviews illustrated the municipality's evolving and demanding role, acting as a mediator between the distribution system operator and property developers. The municipality was responsible for facilitating the process, while other actors, such as the interviewed property developers, placed significant demands on them. The previous agreements between the municipality, the distribution system operator, and the water and sewage company were, according to the municipality, established to facilitate preparatory collaboration with the distribution system operator and engage them in the process (see Kojonsaari & Palm, 2021). However, the agreement did not include the property developers, who were left out of it.

Energy communities

The two ECs in this thesis, cases 3 and 4, were analyzed in the multiple-case study in Paper V. These ECs aim to enable local citizens and businesses to invest in renewable energy, particularly solar power, while lowering financial and technical barriers to participation. The members of the EC participate mainly as shareholders rather than actively engaged decision-makers.

In the first EC, the community is structured around the 736 members (as of February 2025). The community is governed as an association with a governing board. The aim is to balance financial, environmental, and cooperative objectives. Both formal governance structures and informal participation dynamics shape the roles within this EC. The community's main purpose is to enhance members' economic benefits through renewable energy generation while also promoting sustainability awareness and potential profit-sharing (Kojonsaari & Palm, 2021). The governance structure includes formal statutes that regulate decision-making and define the community's objectives.

Local flexibility markets

The role constellation in Sweden’s local flexibility markets (LFMs), in the case of CoordiNet in case 5, is centered on the interaction between multiple actors involved in the provision and procurement of flexibility services for electricity distribution. These markets aim to procure flexibility as a resource to manage grid congestion and increase the efficiency of the electricity system. The different roles in the LFMs we could observe are discussed below.

The flexibility service providers and potential service providers played a central role here. These organizations offer flexibility services to adjust electricity demand or production, whereas the potential flexibility service providers are entities that have the capacity to provide flexibility but have chosen not to participate. Potential providers hesitate to participate due to perceived financial, technical, and regulatory barriers.

Another main actor here was the aggregators, who are the third-party actors that bundle flexibility resources from multiple providers to offer them in the market, thereby lowering entry barriers for smaller players. They act as intermediaries, facilitating participation and cooperation between the other actors in the market. The findings indicate a need to strengthen their role to enhance participation from flexibility service providers and potential flexibility service providers. Due to their ability to simplify market entry and participation, the findings also suggest that aggregators play a significant role in future smart grids.

Another actor in the LFMs was the district system operators. As presented earlier in the thesis, they are responsible for grid stability and operation and, in this case, procure flexibility services from the flexibility market. They procure flexibility from service providers to manage grid congestion and optimize distribution. However, Paper II did not focus specifically on their role in the LFM but more on the role of the flexibility service providers and potential flexibility service providers.

Barriers for local smart grid development

This section is guided by research question two, which was: How do professional actors perceive and navigate barriers in local smart grid development? This question aimed to investigate the barriers that professional actors encounter within the local contexts of smart grid development. The findings here, too, are based on the five studied cases.

In case 1, the project had a top-down approach, which prioritized the participation of professional stakeholders and municipal authorities. The project's complexity made it difficult for individuals without professional expertise in the field to engage in the project in the early stages. Although ideas of energy democracy, sharing, and community involvement were present, they were carried out in a top-down manner by the municipal housing company, aligning with the model of "someone else does it for you." (See more in Palm et al., 2025).

In case 2, we could observe several barriers. The analysis in this case also included viewing the missed windows of opportunities for sustainable intervention that can be seen as barriers. The window of opportunity concept originally stems from the public policy field (Kingdon, 1995), and it was used in this case to identify missed opportunities in the urban energy planning process. The two observed missed opportunities in this case were the establishment of an EC and the role of the sustainability coordinator. Some of the property developers advocated for an energy community, and while property developers initially pushed for energy-sharing solutions, such as a microgrid or direct current grid, they ultimately accepted the distributed energy system model proposed by the distribution system operator due to legal and economic constraints. The municipality envisioned the sustainability coordinator, but the property developers rejected the role due to uncertainties regarding costs and responsibilities.

Prior to including property developers, the municipality had made an agreement with the distribution system operator and the water and sewage company. This contributed to some conflicts as some of the property developers perceived the distribution system operator as acting out of self-interest, which was somewhat in conflict with the municipality's role in representing the public: "Yes, the distribution system operator is a powerful actor, but they are acting out of self-interest." (Property Developer 1) (see also Kojonsaari & Palm, 2021).

The municipality's somewhat ambiguous role in this case contributed to a lack of clear leadership and resulted in fragmented decision-making, inefficiencies, and missed collaboration opportunities. Although many property developers later recognized the need for a coordinator, it became a missed opportunity. The sustainability coordinator's role could have improved the overall process by setting deadlines and keeping the meetings and timing of the meeting agenda items on track.

It was revealed in the interviews, that several property developers would have wished for a stronger leadership from the municipality. This is how one of the property developers articulated their frustrations toward the dialogue process:

> *Very much has not really been, as I feel, thoroughly worked through by the municipality, but rather just thoughts and ideas they have had, and then we are supposed to find solutions for it. It would have been much better if they had a finished concept from the start—this is how you should do it. So, there has been a lot of talk and little action, which has finally resulted in something in the end.* (Informant D1)

However, the energy community proposal was met with barriers. Some property developers supported the idea of community energy with local benefits, while others were in opposition due to potential financial risks and the administrative part of it. As a compromise, the property developers installed empty conduits to enable a potential future microgrid, but the lack of regulatory clarity remained a key barrier for the energy community.

In case 5, we conducted a clear barrier and drivers' analysis, which makes it easier to analyze them in that case. In case 4, the main barriers to participation in the LFM were lack of flexibility in organizations, costs exceeding the benefits, difficulties in understanding the market logic, lack of the technical prerequisites and solutions such as information and communication technology and automation systems, regulations and permissions, functional requirements; separate flexibility markets (see more in Palm et al., 2023).

The main drivers for participation in the LFMs were personal engagement, public relations, goals and strategy, networks and engagement in related forums, flexibility resources, potential revenues and avoidance of future costs, the opportunity to learn and influence, access to aggregation services, contribution to social responsibility, regulations, and political signaling (see more in Palm et al., 2023).

Local smart grid development faces a range of challenges, as seen in five case studies. One common issue is that projects are often led by municipal authorities and industry professionals, with little early involvement from local communities and non-experts. Structural and institutional hurdles also play a role, such as missed opportunities in urban energy planning, conflicts between city governments and grid operators, and a lack of clear leadership. Legal and financial roadblocks, including regulatory uncertainty, make it difficult to implement energy-sharing initiatives and build energy communities. On top of that, organizational issues, like rigid structures and high costs, limit participation in local flexibility markets. In the end, bureaucratic hurdles and financial uncertainties make property developers hesitant to invest in community energy projects. Instead, they resorted to half-measures, like installing empty conduits that may or may not be used in the future.

Implications for energy democracy

This section explores the findings related to research question three, which was: What are the implications of evolving actor roles for democratic energy governance? This question aimed at bridging the planning processes of smart grids and energy democracy, analysing the local cases through the lens of energy democracy and examining the broader connections between these processes and democratic principles.

The findings show that the implications for energy democracy vary depending on the actor. It is clear that the distribution system operators and municipalities need to adapt to more active consumers, and accommodating distributed energy systems is essential. One possible pathway is that distribution system operators start and continue, as seen in the case of Simrishamn, also mentioned above, where the local distribution system operator tested new business models in regard to the microgrid and explored how to align business models with the principles of energy democracy.

In case 1 the strong municipal presence resulted in a largely top-down approach, with limited involvement from current or future residents. While some efforts were made to engage citizens, they were largely unsuccessful. Despite this, the municipality's representative role meant it was still considered responsible for ensuring that energy planning aligned with broader public interests. The findings from case 2 revealed that decisive leadership, regulatory clarity, and an early focus on shared values are crucial for enabling more sustainable and democratic urban energy planning.

In both of the urban smart grid projects, the distribution system operator's role differed, in case 1 it was owned by the municipality and in case 2, it was operating as a private company. We could observe in both cases the ideas of energy democracy and community aspects, but the top-down structures of these projects seemed to act as a barrier for the realization of energy democracy in practice. It seemed that the technical complexities created a knowledge gap between the incumbent energy actors and the citizens (see more in Palm et al., 2025).

As seen in the EC cases, the handing over to the citizens did not work. The ECs studied in this thesis have materialised while the EC discussed in the case of Sege Park is a vision. EC projects have the ambition to improve the direct participation and thus contribute to energy democracy. However, we found that this is not always the case, but there lies a potential in the urban development projects to include the citizens, an unrealized potential perhaps.

From the findings based on the individual papers, it is also possible to conclude that missed opportunities, lack of leadership and regulatory clarity hindered sustainability projects. Planning processes in areas like energy transitions and sustainable urban development often contend with uncertainties and dynamic external conditions.

This transition phase is a struggle as new dynamic emerge and old status quos and the way of doing things changes. Even though not new actors, the distribution system operators and the municipalities are facing new demands along with the energy transition. The different roles of the actors participating. In the case of Sege Park, the residents living in the area were not involved in the planning of the smart grid or the possible energy community or microgrid, yet the stakeholders in the planning process did not want to make certain decisions on their behalf, thus no decisions were made. The agency of the different actors' changes throughout the project and this makes it very difficult to coordinate.

Despite energy democracy's potential to enhance citizen participation and decentralization, several barriers hinder its realization. For example, structural and institutional barriers, particularly in the top-down governance models used in municipal-led projects, as seen here, become barriers. In the ECs, handing over to the citizens was challenging. Planned ECs struggled to materialize due to administrative, technical, and economic constraints. Actors like municipalities and district system operators try to navigate complex structures.

Case 2 illustrates this tension. Residents were not included as stakeholders in the energy planning process, while the included stakeholders did not want to make decisions on their behalf, leading to decision paralysis. The lack of citizen involvement in these projects, despite the municipality's role in representing the public's interest, stands in the way. Furthermore, missed opportunities, such as those seen in case 2, regulatory uncertainty, and lack of leadership, hinder democratic energy governance. However, leadership and more inclusive planning processes coupled with energy democracy have the potential to bridge the gap between technological advancements and democratic energy governance.

Discussion

This section briefly synthesizes the key findings in relation to existing research and discusses them within the broader discourse on smart grid development and energy democracy. The discussion highlights the role of municipalities in facilitating energy democracy, the tensions between top-down and bottom-up approaches, and the implications of stakeholder inclusion in smart grid projects.

Top-down/bottom-up approaches in energy democracy

The question of how energy democracy operates across different scales has been discussed in previous research (Busch et al., 2023). The findings of this thesis reinforce the central role of municipalities, particularly in Sweden, where local planning projects influence smart grid development. Since citizen participation is critical to energy transitions (Renström, 2019; Giotitsas et al., 2022) and social acceptance is a key factor in smart grids (Skjølsvold et al., 2015), municipalities play a pivotal role. However, municipal roles vary depending on whether they own an energy utility or collaborate with private distribution system operators.

Different interpretations of 'Smart Grids'

The findings highlight the ambiguity of the term "smart grid" which can result in varying interpretations and different outcomes on local planning as shown in case 2. This was visible particularly in Paper 3, where two competing discourses were observed, both carrying different values. Thus, critical engagement with how smart grid is conceptualized is necessary to prevent misalignment between global visions and local needs.

Scholars have proposed viewing energy democracy as a process that actively shapes social roles and relationships (Laakso et al., 2023). Incorporating energy democracy principles into municipal planning could provide a pathway for more inclusive and participatory smart grid development. In this context, citizen engagement should be seen not only as a procedural requirement but as an integral component of energy system transformation.

Participation in theory and practice

At the EU level, several policy frameworks discussed above recognize citizens as key stakeholders in energy transition. However, their practical inclusion in urban smart grid projects is lagging behind. Translating the visions into reality is a complex task.

Previous research has shown that while participation is often recommended in theory, it is frequently resisted in practice (Khakee, 2000; Pacione, 2013). Applying an energy democracy framework could help strengthen participatory planning in smart grid projects, ensuring that local communities are treated as central stakeholders.

However, as seen in the cases studied here, urban redevelopment projects often face the challenge of residents not having moved in, which makes community involvement particularly complex. The included stakeholders might not want to make decisions on the future dwellers' half. Here, again, municipalities play a key role in leading the process, and there is a potential to experiment more on this and find ways to engage future dwellers and communities. The municipalities that own municipal energy utilities may be better positioned to experiment with such approaches.

Reframing 'Smartness' in Energy Transitions

Hollands (2008) argued that real smart cities must take greater risks with technology, devolve power, address inequalities, and redefine what 'smart' means. The same applies to smart grids: A truly smart grid must integrate democratic principles rather than simply advancing technological efficiency.

One municipal strategy to align smart grid development with climate goals is to incorporate climate action into binding planning documents (Guyadeen et al., 2023). This approach was evident in Case 2, where agreements between the municipality, the distribution system operator, and the water and sewage company played a defining role. However, the exclusion of property developers led to friction in the planning process, demonstrating the challenges of coordination and timing with diverse stakeholders.

Fenton et al. (2016) highlighted that a crucial aspect of municipal climate planning is determining who is considered a stakeholder—and, more importantly, who is not. Why is the local community not recognized as the most important stakeholder in smart grid development?

While participatory planning is often framed as a democratic ideal, critical research has shown that it has several weaknesses. In some cases, participation has been used to legitimize decisions rather than meaningfully influence them (Carr, 2013). Moreover, it can serve to neutralize opposition and reframe non-democratic politics as citizen-driven (Carr, 2013). Given these limitations, a more critical and conceptually robust understanding of energy democracy is needed to address the shortcomings of participatory planning in smart grid development.

Energy Communities and Flexibility Markets

While direct involvement in EC1 and EC2 has the potential to enhance energy literacy and empower citizens to participate actively in the transition to renewable energy, persistently low levels of engagement hinder its effectiveness. As Laakso et al. (2023) emphasize, given the urgency of the climate crisis, waiting for bottom-up energy communities to emerge organically may not be viable. Furthermore, motivations for community energy participation differ across countries (Soiero & Ferreira Dias, 2020), requiring context-specific analysis.

Flexibility markets present another avenue for smart grid innovation, yet they rely on a market-based logic that differs fundamentally from community energy models. As Gudeman (2012) suggests, market-driven and community-driven approaches coexist as competing paradigms, similar to the paradoxical "rabbit-duck" illusion, where one can see either image but not both simultaneously.

Ultimately, in the studied cases, smart grid development seems to reflect the tension between top-down solutions and bottom-up community-driven approaches. Integrating energy democracy principles into planning processes has the potential to ensure that smart grid transitions are inclusive and participatory.

Conclusions

This thesis has examined the evolving roles of professional actors in Sweden's smart grid development and the barriers they perceive, with a particular focus on energy democracy. The study focused particularly on the role of experts in municipal projects and their potential as enablers of energy democracy in the local smart grid development. It investigated who was involved in local energy planning, how professional actors perceived and navigated barriers, and analyzed the implications of governance structures for advancing ED. By analyzing roles as a socio-technical dimension, the study examined the drivers that shaped smart grid development and its democratic potential.

The analysis was based on five research papers, interpreted through a multi-level theoretical framework integrating socio-technical systems (Hughes, 1983), energy democracy (e.g., Clarke, 2017; Szulecki, 2018; van Veelen & van der Horst, 2018), and the concept of roles from social interaction research.

To achieve the aim of advancing the understanding of how various actors engage in different local smart grid projects in Sweden by identifying the perceived roles and barriers the professionals face in the local smart grid development projects and exploring how these findings can be understood from the perspective of democratic energy governance, the following three research questions were posed at the beginning and answered below:

RQ1: Which professional actors are involved in the studied local energy planning and local flexibility markets?

Smart grids are seen as key elements of a transition to a more sustainable energy system. The involved professional actors in the five local smart grid development projects were municipalities, distribution system operators, property developers and emerging stakeholders such as energy communities, flexibility service providers, and aggregators.

RQ2: How do professional actors perceive and navigate barriers in local smart grid development?

Based on the findings, it is possible to synthesize that role conflicts can lead to uncertainty and, in some cases, missed opportunities to achieve sustainability goals.

The studied municipalities in this thesis seemed to face role ambiguity. While they were expected to facilitate smart grid development, they frequently relied on other existing stakeholders, such as distribution system operators or property developers, as we could observe in case 2 in this thesis. In case 1, the municipality had perhaps a clearer role, and here, they also had the municipally owned energy utility in their corner, so to speak. This perhaps made their mandate somewhat clearer, and less negotiation was needed.

In the LFM demonstration we investigated drivers and barriers for participation in flexibility markets. The findings show that the key drivers were aggregator support, simplifying participation; personal engagement and interest in solving grid congestion; economic potential and access to new knowledge; public relations benefits for participating organizations. Moreover, the study also identified significant barriers, including complexity of market design, making it difficult for participants to navigate; regulatory challenges and policy uncertainty; manual processes, making participation time-consuming; low profitability and potential conflicts with core business operations.

RQ3: What are the implications of evolving actor roles for democratic energy governance?

Based on the findings, it is possible to conclude that the top-down planning approaches by the municipalities in the urban development projects might hinder the energy democracy to realize in these projects. Lack of citizen involvement in these projects hinders energy democracy.

As agencies shift and the roles evolve, the decision making becomes more complex. Property developers are hesitant to represent the dwellers, and perhaps private actors should not be regarded as representing the public, as they are driven by other market principles in the market environment in which they operate. Energy democracy might help to solve the complex value conflicts in the planning processes, if the municipalities were to use it strategically as a tool toward sustainably energy futures.

Theoretical contributions

With the conceptual coupling of energy and democracy, the research field of energy democracy is developing. The findings of this thesis suggest the conceptual development of energy democracy toward separating direct energy democracy and representative energy democracy. The benefits of this would be to enable further development of both concepts and the discovery of the concept's differences and similarities. The specification of these concepts could allow for further theoretical development and enable further theoretical, as well as practical, discoveries in both avenues. More specifically, it could aid in realizing the potential that lies in the representative arena of energy democracy for more sustainable future energy systems.

Practical contributions

Even though this thesis did not focus on the policies, the findings suggest a need for policies that take into consideration the breadth of the local realities. Furthermore, the role of the municipalities and the long-withstanding implications of selling their local energy companies are notable in the development of smart grids. With municipally owned energy utilities, the municipalities have more room to dictate the processes while entering into agreements with the private distribution system operators, which may become a barrier to cooperation and innovation. The key takeaway for the municipality's planning practices is that most property developers wished for stronger leadership and structured processes. Thus, one contribution to practice is to reveal some of the unintended consequences of the agreements that aim for greater sustainability, which might end up becoming barriers when excluding stakeholders. Taking the window of opportunity approach into account when planning the processes is a valuable insight for the stakeholders. These takeaways might be helpful for the municipality's sustainability work, which often focuses on continued learning and development.

Limitations

There may be some possible limitations to this thesis. The smart grid might mean different things to different actors. This research is based on professional actors' perspectives. Adding a diversity of perceptions and experiences could have added greater nuance to the data analysis process. A key challenge identified in Paper I was the abstract nature of the smart grid in its early stages, making it difficult to study actors' direct experiences, as these experiences were not readily available through the cases and actors included in the research. The analytical openness raises important questions about which types, or whose, smart grid solutions emerge and are implemented. As smart grid technologies have become more integrated across sectors, it is increasingly possible to study them as practices rather than as abstract entities in the planning stages alone. Alternatively, we can now attain more diverse knowledge on how different actors, across sectors, interact with the smart grid professionally, but also in their everyday lives as active citizens. The findings of this thesis further highlight the need for a more explicit examination of participation, inclusivity, and democratic governance structures in smart grid development across a spectrum of actors. Future research could evaluate the lived experiences and roles of citizens in the ideation, implementation, and running of smart grid projects.

Future research

The role of citizens in energy planning processes demands further research. Not only are the roles of distribution system operators or municipalities relevant here, but also different community energy constellations and demographic imbalances from an intersectional perspective, such as gender, age, ability, ethnicity, and imbalances in the energy field. Future research could focus on examining the critical role of municipalities within the field of energy democracy and representative energy democracy.

Moreover, the evolving role of women in energy democracy is particularly intriguing—for instance, what role conflicts emerge as women, who have been minorities in energy systems, take on new roles in the energy transition and smart grid constellations in particular? What implications does this have for energy democracy?

Furthermore, there is a relatively small body of qualitative research regarding the growing role of aggregators in the development of smart grids and flexibility resources. More energy social science studies focusing on aggregators could reveal further insights into the landscape these actors navigate in and further investigate their role in the wider energy transition, perhaps even with the gender perspective that could help to analyze why these fields are still largely dominated by men and what implications this might in regard to lost potential in a wider sustainability agenda.

Finally, as the energy transition unfolds, the challenge lies not only in advancing technological solutions but in ensuring that governance structures evolve to accommodate new actors and diverse perspectives. Prioritizing both environmental sustainability and inclusive participation will be essential in shaping sustainable energy systems. The timing of decisions and the capacity to adapt will determine the effectiveness of these transitions and development paths. The way we navigate these complexities today and the development paths that are chosen will set the foundation for the energy systems of the future.

Epilogue

A special thanks for the financial contribution from the Foundation for the International Institute for Industrial Environmental Economics and the Foundation in memory of Lars Inge Grundberg for supporting the finalization and the printing of this PhD thesis.

Looking back on this journey, my understanding of smart grids, energy, and the processes of energy transition and transformation has expanded exponentially over the past years. I have also gained a deeper appreciation of what academia entails and the many meanings it can hold.

I encountered several challenges along the way, the greatest being the COVID-19 pandemic, which struck soon after I began my project. From a research perspective, this unexpected turn required agile course correction. The planned fieldwork in Stockholm had to be abandoned, and alternative approaches had to be devised.

Through this, I learned to navigate uncertainty, initially under the firm guidance of my esteemed supervisor, Jenny, and later, with mentorship and support also from Daniela and other colleagues at the IIIEE and within the Resistance & Effect research project. We PhD students at the institute learned to lean on one another and weather the storm together. I am certain we all developed new coping skills as we adapted to working in front of screens, unable to meet in person.

It is safe to say that a great deal has happened over these five years, and new, empowering roles have been embraced. Beyond academic achievements, this journey has taught me resilience and the value of collaboration. It has also shown me that one should not wait for a crisis to take a leap of faith. I am deeply grateful to the colleagues, mentors, friends, and family who have supported me along the way—I could not have done this alone.

References

Ballo, I. F. (2015). Imagining energy futures: Sociotechnical imaginaries of the future Smart grid in Norway. *Energy Research & Social Science*, 9, 9–20. https://doi.org/10.1016/j.erss.2015.08.015

Bauwens, T., Schraven, D., Drewing, E., Radtke, J., Holstenkamp, L., Gotchev, B., & Yildiz, Ö. (2022). Conceptualizing community in energy systems: A systematic review of 183 definitions. *Renewable and Sustainable Energy Reviews*, 156, 111999.

Bhaskar, R. (1975). *A Realist Theory of Science*. Routledge.

Biddle, B. J. (1986). Recent Developments in Role Theory. *Annual Review of Sociology*, *12*(1), 67–92. https://doi.org/10.1146/annurev.so.12.080186.000435

Biresselioglu, M. E., Limoncuoglu, S. A., Demir, M. H., Reichl, J., Burgstaller, K., Sciullo, A., & Ferrero, E. (2021). Legal Provisions and Market Conditions for Energy Communities in Austria, Germany, Greece, Italy, Spain, and Turkey: A Comparative Assessment. *Sustainability*, *13*(20), 11212. https://doi.org/10.3390/su132011212

Bryman, A. (2012). *Social research methods* (4th ed). Oxford University Press.

Bryman, A., & Bell, E. (2015). *Business Research Methods* (4th ed.). Oxford: Oxford Univ. Press.

Busch, H., Radtke, J., & Islar, M. (2023). Safe havens for energy democracy? Analysing the low-carbon transitions of Danish energy islands. *Zeitschrift Für Politikwissenschaft*, *33*(2), 227–251. https://doi.org/10.1007/s41358-023-00347-5

Busch, H., Ruggiero, S., Isakovic, A., & Hansen, T. (2021). Policy challenges to community energy in the EU: A systematic review of the scientific literature. *Renewable and Sustainable Energy Reviews*, *151*, 111535. https://doi.org/10.1016/j.rser.2021.111535

Böhnke, R. F., Hoppe, T., Brezet, H., & Blok, K. (2019). Good practices in local climate mitigation action by small and medium-sized cities: Exploring meaning, implementation, and linkage to actual lowering of carbon emissions in thirteen municipalities in the Netherlands. *Journal of Cleaner Production, 207*, 630–944. https://doi.org/10.1016/j.jclepro.2018.09.264

Carr, J. (2013). Making urban politics go away: The role of legally mandated planning processes in occluding city-level power. In M. Davidson & D. Martin (Eds.), *Urban politics: Critical approaches* (pp. 112-129). SAGE Publications. https://doi.org/10.4135/9781526402158.n7

Clarke, C. E. (2017). “Incorporating citizen engagement in energy development decision,” in *Presented at the Energy Democracy Symposium* (Salt Lake City, UT).

Collins, K., & Ison, R. (2006, June 4–7). Dare we jump off Arnstein's ladder? Social learning as a new policy paradigm. Paper presented at the PATH (Participatory Approaches in Science and Technology) Conference, Edinburgh, Scotland.

Creswell, J. W. & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (Fifth edition). SAGE.

Dekker, K., & Van Kempen, R. (2009). Participation, Social Cohesion and the Challenges in the Governance Process: An Analysis of a Post-World War II Neighbourhood in the Netherlands. *European Planning Studies*, *17*(1), 109–130. https://doi.org/10.1080/09654310802514011

Delamont, S. (2003). Exploring qualitative research methods. In J. Smith & R. Brown (Eds.), *The handbook of qualitative research* (pp. 200–220). Sage Publications.

Diener, E., & Crandall, R. (1978). *Ethics in social and behavioral research*. University of Chicago Press.

Dincer, I., & Abu-Rayash, A. (2020). Community energy systems. In *Energy Sustainability* (pp. 101–118). Elsevier. https://doi.org/10.1016/B978-0-12-819556-7.00005-X

Energy Institute. (2024). Statistical review of world energy. https://www.energyinst.org/statistical-review

Energy Market Inspectorate. (2012). Elområden i Sverige (Ei R2012:06). Energy Market Inspectorate.

E.ON. (2017). *E.ON implements a stand-alone grid solution in Sweden*. Retrieved from https://www.eon.com/en/about-us/media/press-release/2017/eon-implements-a-stand-alone-grid-solution-in-sweden.html Accessed 7 February 2025.

European Commission. (2019a). *The European Green Deal* (COM/2019/640 final). EUR-Lex. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019DC0640

European Commission. (2019b). *Clean energy for all Europeans.* Publications office of the European Union https://opeuropaeu/en/publication-detail/-/publication/b4e46873-7528-11e9-9f05-01aa75ed71a1. Accessed 20 September 2024

European Parliament and Council. (2023). Directive (EU) 2023/2413 of the European Parliament and of the Council of 18 October 2023 amending Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources, supplementing Regulation (EU) 2018/1999, and repealing Council Directive (EU) 2009/28/EC. Official Journal of the European Union, L 2023/2413, 1–50. https://eur-lex.europa.eu/eli/dir/2023/2413/oj

European Technology Platform SmartGrids. (n.d.). SmartGrids: Strategic deployment document for Europe's electricity networks of the future. Publications Office of the European Union. https://op.europa.eu/en/publication-detail/-/publication/a2ea8d86-7216-444d-8ef5-2d789fa890fc/language-en

Feldpausch-Parker, A. M., Endres, D., & Peterson, T. R. (2019). Editorial: A Research Agenda for Energy Democracy. *Frontiers in Communication*, *4*, 53. https://doi.org/10.3389/fcomm.2019.00053

Feldpausch-Parker, A. M., Endres, D., Peterson, T. R., & Gomez, S. L. (Eds.). (2022). *Routledge handbook of energy democracy*. Routledge. https://doi.org/10.4324/9780429402302

Fenton, P., Gustafsson, S., Ivner, J., & Palm, J. (2016). Stakeholder participation in municipal energy and climate planning – experiences from Sweden. *Local Environment*, *21*(3), 272–289. https://doi.org/10.1080/13549839.2014.946400

Fung, A. (2006). Varieties of Participation in Complex Governance. *Public Administration Review*, *66*(s1), 66–75. https://doi.org/10.1111/j.1540-6210.2006.00667.x

Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy*, *31*(8–9), 1257–1274. https://doi.org/10.1016/S0048-7333(02)00062-8

Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research Policy*, *33*(6), 897–920. https://doi.org/10.1016/j.respol.2004.01.015

Geertz, C. (2009). *The interpretation of cultures: Selected essays* (Repr.). Basic Books.

Giotitsas, C., Nardelli, P. H. J., Williamson, S., Roos, A., Pournaras, E., & Kostakis, V. (2022). Energy governance as a commons: Engineering alternative socio-technical configurations. *Energy Research & Social Science*, *84*, 102354. https://doi.org/10.1016/j.erss.2021.102354

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research.* (pp. 105–117). Sage Publications, Inc.

Gudeman, S. 2012. Community and economy: economy's base. In *Handbook of Economic Anthropology*, Second Edition. Edited by Carrier, James G. Edward Elgar Publishing Inc., Northamton, MA, USA.

Guyadeen, D., Henstra, D., Kaup, S., & Wright, G. (2023). Evaluating the quality of municipal strategic plans. *Evaluation and Program Planning*, *96*, 102186. https://doi.org/10.1016/j.evalprogplan.2022.102186

Hallgren, T. (1997). *Fakta och Argument om Kommunala företag*, Stockholm: Svenska Kommunförbundet.

Hammersley, M., & Atkinson, P. (2007). *Ethnography: Principles in Practice* (3rd ed.). Routledge. https://doi.org/10.4324/9780203944769

Hargreaves, N., Hargreaves, T., & Chilvers, J. (2022). Socially smart grids? A multi-criteria mapping of diverse stakeholder perspectives on smart energy futures in the United Kingdom. *Energy Research & Social Science*, *90*, 102610. https://doi.org/10.1016/j.erss.2022.102610

Hay, I. (Ed.). (2016). *Qualitative research methods in human geography* (4th ed.). Oxford University Press.

Hojčková, K., Sandén, B., & Ahlborg, H. (2018). Three electricity futures: Monitoring the emergence of alternative system architectures. *Futures*, *98*, 72–89. https://doi.org/10.1016/j.futures.2017.12.004

Hughes, T. P. (1987). The evolution of large technological systems. *The social construction of technological systems: New directions in the sociology and history of technology*, *82*, 51-82.

Hughes, T. P. (1993). *Networks of power: Electrification in Western society, 1880-1930* (Softshell Books ed). Johns Hopkins University Press.

Intergovernmental Panel on Climate Change (IPCC). (2021). Climate change 2021: The physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. https://www.ipcc.ch/report/ar6/wg1/

International Energy Agency. (2024). *Sweden: Energy mix*. Retrieved from https://www.iea.org/countries/sweden/energy-mix Accessed 6 February 2025.

Kaijser, A. (1992). Redirecting Power: Swedish Nuclear Power Policies in Historical Perspective. *Annual Review of Energy and the Environment*, *17*(1), 437–462. https://doi.org/10.1146/annurev.eg.17.110192.002253

Karvonen, A., Cugurullo, F., & Caprotti, F. (Eds.). (2019). *Inside smart cities: Place, politics and urban innovation*. Routledge.

Khakee, A., 2000. *Samhällsplanering. Nya mål, perspektiv och förutsättningar.* Lund: Studentlitteratur.

Kingdon, J. W. (1995). *Agendas, alternatives, and public policies.* New York: HarperCollins College Publishers.

Kojonsaari, A.-R., & Palm, J. (2021). Distributed energy systems and energy communities under negotiation. *Technology and Economics of Smart grids and Sustainable Energy*, 6(1), Article 17. https://doi.org/10.1007/s40866-021-00116-9

Kojonsaari, A.-R., & Palm, J. (2023). The development of social science research on smart grids: A semi-structured literature review. *Energy, Sustainability and Society*, 13(1). https://doi.org/10.1186/s13705-023-00381-9

Kojonsaari, A.-R., Palm, J., & Lazoroska, D. (Manuscript). Timing in energy planning of sustainable city districts: Windows of opportunities and lost potential.

Krantz, V., & Gustafsson, S. (2021). Localizing the sustainable development goals through an integrated approach in municipalities: early experiences from a Swedish forerunner (Article). *Journal of Environmental Planning and Management*, 64(14), 2641-2660. https://doi.org/10.1080/09640568.2021.1877642

Kvale, S., & Brinkmann, S. (2009). *InterViews: Learning the craft of qualitative research interviewing*. Sage Publications.

Laakso, S., Eranti, V., & Lukkarinen, J. (2023). Practices and acts of energy citizenship. *Journal of Environmental Policy & Planning*, *25*(6), 690–702. https://doi.org/10.1080/1523908X.2023.2251915

Langendahl, P. A., Cook, M., & Potter, S. (2014). Smoothing peaks and troughs: Intermediary practices to promote demand side response in smart grids. *Science and Technology Studies*, 27(3), 72–91.

Latour, B. (2010). *An attempt at writing a compositionist manifesto.* New Literary History, 41(3), 471-490.

Lazoroska, D. (2023). Aging into tricksters: A qualitative study of women's positioning and leadership in solar energy communities in Japan. *Energy, Sustainability and Society*, *13*(1), 17. https://doi.org/10.1186/s13705-023-00396-2

Linton, R. (1936). *The study of man.* Appleton-Century.

Listerborn, C., & de Neergaard, M. (2021). Uncovering the 'Cracks'? Bringing feminist urban research into smart city research. *ACME: An International Journal for Critical Geographies*, 20(3), 294–311. https://doi.org/10.14288/acme.v20i3.2009

Lovell, H. (2022). *Understanding Energy Innovation: Learning from Smart grid Experiments*. Springer Singapore. https://doi.org/10.1007/978-981-16-6253-9

Magnusson, D. (2016). Who brings the heat? – From municipal to diversified ownership in the Swedish district heating market post-liberalization. *Energy Research & Social Science*, *22*, 198–209. https://doi.org/10.1016/j.erss.2016.10.004

McKasy, M., & Yeo, S. K. (2021). Carbon neutral pledges. In A. M. Feldpausch-Parker, D. Endres, T. R. Peterson, & S. L. Gomez (Eds.), *Routledge handbook of energy democracy* (pp. 362-375). Routledge. https://doi.org/10.4324/9780429402302

Mead, G. H. (1934). Mind, self, and society. University of Chicago Press.

Meletiou, A., Vasiljevska, J., Prettico, G., & Vitiello, S. (2023). Distribution System Operator Observatory 2022. Publications Office of the European Union. https://doi.org/10.2760/90495

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). Qualitative data analysis: A methods sourcebook (Third edition). SAGE Publications, Inc.

Minniti, S., Haque, N., Nguyen, P., & Pemen, G. (2018). Local markets for flexibility trading: Key stages and enablers. *Energies*, 11(11), 3074. https://doi.org/10.3390/en11113074

Monno, V., & Khakee, A. (2012). Tokenism or Political Activism? Some Reflections on Participatory Planning. *International Planning Studies*, *17*(1), 85–101. https://doi.org/10.1080/13563475.2011.638181

Moroni, S. (2024). Energy communities, distributed generation, renewable sources: Close relatives or potential friends? *Energy Research & Social Science*, *118*, 103828. https://doi.org/10.1016/j.erss.2024.103828

Månsson, M. (2023, June 2). Österlenby i centrum för unikt elprojekt – nu avslutas det. *Sveriges Radio*. https://www.sverigesradio.se/artikel/osterlenby-i-centrum-for-unikt-elprojekt-nu-avslutas-det

National Academy of Sciences, National Academy of Engineering, & Institute of Medicine. (2005). *Facilitating interdisciplinary research*. The National Academies Press. https://doi.org/10.17226/11153

Neij, L., & Heiskanen, E. (2021). Municipal climate mitigation policy and policy learning - A review. *Journal of Cleaner Production*, *317*, Article 128348. https://doi.org/10.1016/j.jclepro.2021.128348

Närings- och teknikutvecklingsverket. (1991). *Elmarknad i förändring: Från monopol till konkurrens*. Närings- och teknikutvecklingsverket.

Pacione, M. (2013). Private profit, public interest and land use planning—A conflict interpretation of residential development pressure in Glasgow's rural–urban fringe. *Land Use Policy*, *32*, 61–77. https://doi.org/10.1016/j.landusepol.2012.09.013

Palm, J. (2004). *Makten över energin: Policyprocesser i två kommuner 1977–2001*. https://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-4713

Palm, J., & Bocken, N. (2021). Achieving the Circular Economy: Exploring the Role of Local Governments, Business and Citizens in an Urban Context. *Energies*, *14*(4), Article 4. https://doi.org/10.3390/en14040875

Palm, J., Kojonsaari, A.-R., Öhrlund, I., Fowler, N., & Bartusch, C. (2023). Drivers and barriers to participation in Sweden's local flexibility markets for electricity. *Utilities Policy*, 82, Article 101580. https://doi.org/10.1016/j.jup.2023.101580

Palm, J., Kojonsaari, A.-R. & Magnusson, D. (2025). Toward energy democracy: municipal energy actions in local renewable energy projects. *Energy Research and Social Science*. https://doi.org/10.1016/j.erss.2025.103921

Parag, Y., & Sovacool, B. K. (2016). Electricity market design for the prosumer era. *Nature Energy*, *1*(4), 1–6. https://doi.org/10.1038/nenergy.2016.32

Parvin, P. (2018). Democracy Without Participation: A New Politics for a Disengaged Era. *Res Publica*, *24*(1), 31–52. https://doi.org/10.1007/s11158-017-9382-1

Polk, M., & Knutsson, P. (2008). Participation, value rationality, and mutual learning in transdisciplinary knowledge production for sustainable development. *Environmental Education Research, 14*(6), 643–653.

Powell, J., McCafferty-Leroux, A., Hilal, W., & Gadsden, S. A. (2024). Smart grids: A comprehensive survey of challenges, industry applications, and future trends. *Energy Reports*, *11*, 5760–5785. https://doi.org/10.1016/j.egyr.2024.05.051

Ragin, C. C., & Becker, H. S. (Eds.). (1992). *What is a case? Exploring the foundations of social inquiry.* Cambridge University Press.

Renko, V., Johannisson, J., Kangas, A., & Blomgren, R. (2022). Pursuing decentralisation: Regional cultural policies in Finland and Sweden. *International Journal of Cultural Policy*, *28*(3), 342–358. https://doi.org/10.1080/10286632.2021.1941915

Renström, S. (2019). Supporting diverse roles for people in smart energy systems. *Energy Research and Social Science*, *53*, 98–109. https://doi.org/10.1016/j.erss.2019.02.018

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F. S., Lambin, E. F., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., De Wit, C. A., Hughes, T., Van Der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P. K., Costanza, R., Svedin, U., … Foley, J. A. (2009). A safe operating space for humanity. *Nature*, *461*(7263), 472–475. https://doi.org/10.1038/461472a

Rosvall, M., Gustafsson, M., & Åberg, M. (2023). Strategic visions for local sustainability transition: measuring maturity in Swedish municipalities. *Journal of Environmental Policy and Planning*, 25(5), 539-553. https://doi.org/10.1080/1523908X.2023.2218273

Roulston, K. (2010). *Reflective interviewing: A guide to theory and practice*. Sage.

Sahlin-Andersson, K. (1986). *Beslutsprocessens komplexitet: Att genomföra och hindra stora projekt*. Bokförlaget Doxa AB.

Schmidt, S., & Weigt, H. (2015). Interdisciplinary energy research and energy consumption: What, why, and how? *Energy Research & Social Science*, *10*, 206–219. https://doi.org/10.1016/j.erss.2015.08.001

Schuitema, G., & D. Sintov, N. (2017). Should we quit our jobs? Challenges, barriers and recommendations for interdisciplinary energy research. *Energy Policy*, *101*, 246–250. https://doi.org/10.1016/j.enpol.2016.11.043

Scott, J. (1990). *A matter of record: Documentary sources in social research*. Polity Press.

Seale, C., Gobo, G., & Gubrium, J. F. (Eds.). (2005). *Qualitative research practice* (Reprinted). SAGE.

Skjølsvold, T. M., & Ryghaug, M. (2015). Embedding smart energy technology in built environments: A comparative study of four smart grid demonstration projects. *Indoor and Built Environment*, *24*(7), 878–890. https://doi.org/10.1177/1420326X15596210

Skjølsvold, T. M., Ryghaug, M., & Berker, T. (2015). A traveler's guide to smart grids and the social sciences. *Energy Research & Social Science*, *9*, 1–8. https://doi.org/10.1016/j.erss.2015.08.017

Soeiro, S., & Ferreira Dias, M. (2020). Renewable energy community and the European energy market: Main motivations. *Heliyon*, *6*(7), e04511. https://doi.org/10.1016/j.heliyon.2020.e04511

Sonnsjö, H. (2024). What we talk about when we talk about electricity: A thematic analysis of recent political debates on Swedish electricity supply. *Energy Policy*, *187*, 114053. https://doi.org/10.1016/j.enpol.2024.114053

Sovacool, B. K., Axsen, J., & Sorrell, S. (2018). Promoting novelty, rigor, and style in energy social science: Towards codes of practice for appropriate methods and research design. *Energy Research & Social Science*, 45, 12–42. https://doi.org/10.1016/j.erss.2018.07.007

Sovacool, B. K., & Geels, F. W. (2016). Further reflections on the temporality of energy transitions: A response to critics. *Energy Research & Social Science*, *22*, 232–237. https://doi.org/10.1016/j.erss.2016.08.013

Sovacool, B. K., Ryan, S. E., Stern, P. C., Janda, K., Rochlin, G., Spreng, D., Pasqualetti, M. J., Wilhite, H., & Lutzenhiser, L. (2015). Integrating social science in energy research. *Energy Research & Social Science*, *6*, 95–99. https://doi.org/10.1016/j.erss.2014.12.005

Stake, R. (2003). Case studies. In N. K. Denzin & Y. S. Lincoln (Eds.), *Strategies of qualitative inquiry* (2nd Ed.) (pp. 134 - 164). Thousand Oaks, CA: Sage.

Stake, R. E. (1995). *The art of case study research*. Sage Publications.

Stephens, J. C. (2019). Energy Democracy: Redistributing Power to the People Through Renewable Transformation. *Environment: Science and Policy for Sustainable Development*, *61*(2), 4–13. https://doi.org/10.1080/00139157.2019.1564212

Svenska kraftnät. (2023). *EU:s inre elmarknad*. https://www.svk.se/om-kraftsystemet/oversikt-av-kraftsystemet/eus-inr

Svenska kraftnät. (n.d.). The Swedish national grid. https://www.svk.se/siteassets/english/national-grid/svk_grid.pdf

Svenska kraftnät. (2024). Official website. Retrieved from https://www.svk.se/ Accessed 10 October 2024.

Svenska kraftnät. (2024). Långsiktig marknadsanalys: Scenarier för kraftsystemets utveckling fram till 2050. Svenska kraftnät.

Swedish Energy Markets Inspectorate. (2023). *Sweden's electricity and natural gas market 2022* (Ei R2023:13). https://ei.se/download/18.2b54186118afe6e6d30ede/1696496742338/Sweden%E2%80%99s-electricity-and-natural-gas-market-2022-Ei-R2023-13.pdf

Szulecki, K. (2018). Conceptualizing energy democracy. *Environmental Politics*, *27*(1), 21–41. https://doi.org/10.1080/09644016.2017.1387294

United Nations. (2015). *Paris Agreement*. Retrieved from https://unfccc.int/sites/default/files/english_paris_agreement.pdf

Van Rijnsoever, F. J., & Hessels, L. K. (2011). Factors associated with disciplinary and interdisciplinary research collaboration. *Research Policy*, *40*(3), 463–472. https://doi.org/10.1016/j.respol.2010.11.001

van Veelen, B., & van der Horst, D. (2018). What is energy democracy? Connecting social science energy research and political theory. *Energy Research & Social Science*, *46*,

Verkade, N., & Höffken, J. (2019). Collective Energy Practices: A Practice-Based Approach to Civic Energy Communities and the Energy System. *Sustainability*, *11*(11), 3230. https://doi.org/10.3390/su11113230

Voytenko, Y., McCormick, K., Evans, J., & Schliwa, G. (2016). Urban living labs for sustainability and low carbon cities in Europe: Towards a research agenda. *Journal of Cleaner Production*, *123*, 45–54. https://doi.org/10.1016/j.jclepro.2015.08.053

Wahlund, M., & Palm, J. (2022). The role of energy democracy and energy citizenship for participatory energy transitions: A comprehensive review. *Energy Research & Social Science*, *87*, 102482. https://doi.org/10.1016/j.erss.2021.102482

Walker, G., & Devine-Wright, P. (2008). Community renewable energy: What should it mean? *Energy Policy*, *36*(2), 497–500. https://doi.org/10.1016/j.enpol.2007.10.019

Warsi, N. A., Siddiqui, A. S., Kirmani, S., & Sarwar, M. (2019). Impact Assessment of Microgrid in Smart Cities: Indian Perspective. *Technology and Economics of Smart Grids and Sustainable Energy*, *4*(1), 14. https://doi.org/10.1007/s40866-019-0071-3

White, S. C. (1996). Depoliticising development: The uses and abuses of participation. *Development in Practice*, *6*(1), 6–15. https://doi.org/10.1080/0961452961000157564

Williams, L., & Sovacool, B. K. (2020). Energy democracy, dissent and discourse in the party politics of shale gas in the United Kingdom. *Environmental Politics*, 29(7), 1239–1263. https://doi.org/10.1080/09644016.2020.1740555

Winther, T., & Wilhite, H. (2015). Tentacles of Modernity: Why Electricity Needs Anthropology. *Cultural Anthropology*, *30*(4), 569–577. https://doi.org/10.14506/ca30.4.05

Wittmayer, J. M., Avelino, F., Van Steenbergen, F., & Loorbach, D. (2017). Actor roles in transition: Insights from sociological perspectives. *Environmental Innovation and Societal Transitions*, *24*, 45–56. https://doi.org/10.1016/j.eist.2016.10.003

Wolcott, H. F. (1999). *Ethnography: A Way of Seeing*. AltaMira Press.

Wolsink, M. (2012). The research agenda on social acceptance of distributed generation in smart grids: Renewable as common pool resources. *Renewable and Sustainable Energy Reviews*, *16*(1), 822–835. https://doi.org/10.1016/j.rser.2011.09.006

Wästerfors, D., Åkerström, M., & Jacobsson, K. (2014). Reanalysis of Qualitative Data. In U. Flick (Ed.), *The Sage Handbook of Qualitative Data Analysis* (pp. 467–480). SAGE Publications.

Yildiz, Ö., Rommel, J., Debor, S., Holstenkamp, L., Mey, F., Müller, J. R., Radtke, J., & Rognli, J. (2015). Renewable energy cooperatives as gatekeepers or facilitators? Recent developments in Germany and a multidisciplinary research agenda. *Energy Research & Social Science*, *6*, 59–73. https://doi.org/10.1016/j.erss.2014.12.001

Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). Sage Publications.

Wiring Power

The global transition to renewable energy is not only a technological advancement—it is a fundamental transformation of governance, participation, and power dynamics. The smart grid emerges as a key arena where new power structures are drawn, and stakeholders such as municipalities, energy utilities, and energy communities need to navigate both challenges and opportunities. This thesis examines five local smart grid projects in Sweden, exploring the barriers and drivers shaping their development. Regulatory hurdles, uncertainties, and role conflicts hinder sustainable development, while municipal leadership, key champions, and strategic timing act as enablers. The thesis also highlights the absence of citizens in decision-making and how differing interpretations of "smart grids" influence outcomes. By shedding light onto these dynamics, this research contributes to a deeper understanding of energy transition and governance roles in a changing energy landscape.

Printed by Media-Tryck, Lund 2025 NORDIC SWAN ECOLABEL 3041 0903

LUND UNIVERSITY

Faculty of Engineering
International Institute for
Industrial Environmental Economics (IIIEE)

ISBN 978-91-988626-3-8