DEVELOPING A PLATFORM FOR STAKEHOLDER INCLUSION AND COOPERATION

A CONCEPTUAL FRAMEWORK FOR STAKEHOLDERS IN GREATER COPENHAGEN

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SUSTAINABLE ENERGY PLANNING AND MANAGEMENT

AALBORG UNIVERSITY

STUDENT REPORT

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Abstract:

Based on a consensus that the urban space has a distinct role in the energy transition, a problem analysis is carried out to investigate power and administrative relations related to electricity-based energy projects in Greater Copenhagen. From the problem analysis it is concluded that there is a continuous redistribution of power amongst stakeholders where the there is a potential for e-democracy to enable inclusive and efficient governance.

On this basis the potential for a web-based platform is analysed. This is done by; interviewing relevant stakeholders, spatial analyses and mapping in GIS and application of theories (Transition Management and Strategic Niche Management) for two case projects: Onshore wind turbines and rooftop mounted solar PV. The analyses are structured after Design Thinking to support the development of the platform concept.

The analyses result in a proposed conceptual framework. It is found that there is a potential for integrating a platform into governance in Greater Copenhagen, and its' greatest potential lies in citizen inclusion by enabling a more effective two-way communication with stakeholders, as well as introducing a tactical approach for defining potential stakeholders and communication for an energy project. It offers opportunities for a more inclusive and collaborative approach to governance. However, barriers are expected for an innovation project of this nature and there is still some way from conceptual framework to integration into governance, where the need is found to support e-democracy with physical presence and proximity.

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1 REFERAT

Udvikling af en platform til inddragelse af interessenter og samarbejde

- Konceptuelle rammer for interessenter i Storkøbenhavn

Baseret på en forståelse for, at byer har en særskilt rolle for energiomstillingen, udarbejdes en problemanalyse med fokus på magt og administrative forhold, der spiller ind på el baserede energiprojekter i Storkøbenhavn. Dette giver en forståelse for overordnede magtforhold, hvoraf der konkluderes, at der sker en vedvarende omfordeling af disse. En tendens forstærket af nye muligheder indenfor digitalisering og internettet, der forventes at få en voksende betydning for fremtidens energiprojekter. Baseret på dette undersøges potentialet for en web baseret platform i det videre studie, med henblik på at klarlægge muligheder indenfor e-demokrati i regeringsførelsen.

Analyserne består af interviews med relevante interessenter, rumlige analyser med GIS samt anvendelse af teorierne: 'Transition Management' og 'Strategic Niche Management'. Relevant litteratur inddrages desuden løbende til understøttelse af analyserne. Analyserne udføres med fokus på to case projekter: Landvindmøller i Nordhavn samt tagmonterede solceller i et område på Amager. Til strukturering af opgaven bruges 'Design Thinking', der understøtter udviklingen af et nyt produkt, hvor der tages hensyn til forbrugeren i en cyklisk proces af forståelse for forbrugerbehovet, udforskning af løsninger og materialisering af produktet. Analyserne resulterer i konceptuelle rammer for en platform i relation til de to udvalgte cases.

De største barrierer anses som; uenighed blandt interessenter, udfordringer i at bevirke en generel forståelse for energisektoren, og interessen for vedvarende energiprojekter. Der argumenteres desuden for at fysisk tilstedeværelse og nærhed er elementer, der forbliver vigtige for regeringsførelse. Studiet resulterer i en række anbefalinger for, hvordan en platform kan designes for at imødegå de fundne barrierer. Der konkluderes, at der er et potentiale for en platform i regeringsførelsen på energiområdet i Storkøbenhavn, især når det kommer til borgerinddragelse via indførelse af to-vejs-kommunikation mellem interessenter, samt integration af taktikker til udpegning af potentielle interessenter, hvormed disse kan opsøges aktivt.

2 PREFACE

This study has been carried out as a conclusion to the Sustainable Energy Planning and Management program at Aalborg University over the period: 29 March to 7 September 2018. The study addresses the potential for a platform in energy governance in Greater Copenhagen. The study applies cases of onshore wind turbines and rooftop mounted solar PV and through; spatial analyses, literature study and interviews in an iterative process, a concept platform for Greater Copenhagen is designed and proposed.

The researcher of this study would like to give thanks to supervisor Lars Grundahl and Steffen Nielsen employees at Aalborg University, for guidance during the project period. Thanks, is given to Aalborg University for data for the spatial analyses. Additionally, the informants that have contributed; Thomas Nielsen, Niels Kristensen, Christoffer Greisen, Anders Hasselager, Kenneth Karlsson and Giada Venturini, are accredited for offering helpful insights.

The picture on the front page is from Pexels (2018).

3 READING GUIDE

Throughout the study references are included according to the Harvard method and listed in the bibliography. The references are cited by [surname, year] and if the author is unknown by [*Title*, year] where the title is presented in italics. Several references will be separated by semicolon. In cases with same author and year, these will de denoted with a,b,c etc. references that apply to a statement are included in the beginning or as a conclusion to the statement. A statement can comprise of several lines under the same statement, in which case one reference is applied.

Throughout the study; textboxes, figures, maps and tables are used to structure and support the study and will be referred to chronologically i.e. when they occur in the text. Captions are found under each element. In the bibliography, books, articles and reports are referred to by; author, title, publisher, edition, year and when relevant; URL.

4 GLOSSARY

In *Table 1* it is described how frequently used terminology is understood in the study.

Citizens*: Landowners, neighbours and local associations.*

Energy Transition*: The process of transitioning from a fossil fuel-based energy system towards a sustainable energy system based on renewable resources.*

Innovation: *A niche project with potential to scale up and be integrated into the current sociotechnical system*.

Urban space*: Densely built environment managed by local authorities.*

Renewable energy*: Wind and water power, biogas, biomass, solar energy, wave and tidal power and geothermal energy.*

Sociotechnical system: *The coexistence and interaction of people and technology in society.*

Solar PV: *solar photovoltaics producing electricity from sunlight.*

Sustainable practice*: Meeting current people's demands without compromising the ability of future generations to meet their demands.*

Table 1: Glossary of frequently used terminology.

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6 INTRODUCTION

The concern over anthropogenic greenhouse gas emissions has been fueled by; changes in the global climate, melting of the poles, spreading of desert areas and increased frequency of extreme weather occurrences (Coley, 2013). To alleviate this, countries are consenting to reduce emissions by making emitting processes more efficient and converting to sustainable energy (Coley, 2013). Today the share of renewable energy is growing rapidly, where nearly two-thirds of globally implemented electricity capacity in 2016 comprised of renewables. The same year implemented solar PV capacity grew by 50 percent, surpassing net growth in any other fuel (*Renewables...*, 2017). It is evident, that the energy transition implies drastic changes in the energy landscape as we know it.

In some respects, renewable energy production is inclined towards remote mass generation. EU countries are focusing on transnational electricity infrastructure as means to trade electricity across country boundaries. Moreover, solar PV production can be expected to be concentrated in areas of the world where radiation is abundant. Transportation of biomass being relatively energy efficient, biomass production can be expected to be concentrated in areas with feasible conditions for growth (Proverbs & Booth., 2012). Contrariwise, decentralized energy production is a trend alleviating remote mass generation, and there are indicators that local production will shape the future energy system as well; advances in rooftop mounted solar PV, local biomass production and utilisation of excess heat in district heating systems, to name some (Coley, 2013). Local energy production leads to a distinctly different energy landscape and possibilities than remote mass generation, with both geopolitical and local implications. The potential for urban energy production found when examining some tendencies of demography and governance within the urban space is noticeable.

Cities are influenced by clustering of economic activity which in turn attracts people, making cities centres for production and consumption. This self-enhancing accumulation is termed urbanisation and is perceived as an unstoppable process, ongoing since the industrialization of western Europe (Proverbs & Booth., 2012). Cities are characterized by elevated levels of energy consumption and burning of fossil fuels. They are responsible for about 75 percent of the world's energy consumption and 80 percent of global CO_2 emissions (David & Haselmayr, 2012). Adding to this, 5 billion people are expected to live in cities by 2030, corresponding to 60 percent of the world's population (Alhamwi et al., 2017). Urban areas have become centres for knowledge, money and power with corresponding means to be front-runners of innovation

(Proverbs & Booth., 2012). It can be argued that urbanisation is important for the energy transition. It influences the spatial relationship of energy production, transport and consumption. Moreover, urbanisation attributes potentially valuable resources to cities for shaping the future energy system.

Another tendency affecting the importance of urban areas is the decentralisation of power. From hierarchy and bureaucracy, governance has transformed towards self-organising networks, where accumulation of capital depends largely on added value from economic institutions and relations i.e. partnerships and heterarchy, where e.g. firms are seen to strive for political influence (Kearns & Paddison, 2000). Thus, it becomes the responsibility of governing stakeholders to innovate and learn in a complex and changing environment. Decentralisation of power has empowered local authorities and stakeholders and given them tools to develop local visions and goals, enabling cities to develop individual profiles. Designing initiatives for local democracy, is a popular way for cities to distinguish themselves as a desirable place in which to live work and invest (Kearns & Paddison, 2000). Moreover, many cities have sustainable energy production included in local strategies, where terms such as; productive city, CO_2-neutrality and circular metabolism have become popular brands, associated with local economic growth and environmental improvement (Groth et al., 2016). There is arguably a potential for cities to play an important part in the energy transition. As sustainability has become part of the agenda for many cities, it can be considered imperative for the energy transition, how energy becomes a part of these tendencies. As urbanisation and decentralised power, attributes resources and power to cities, it enables them to pave the path in the energy transition. There is a continuous change in the processes and structures of urban space: Economic globalisation, cultural homogenisation and cities that decouple from the national economies. Lastly a tendency seen is cross border cooperation and networking such as city partnerships (Kearns & Paddison, 2000), indicating that the urban areas will become increasingly distinguished in the future.

Denmark is one of the countries which has experienced an ongoing trend for decentralisation of the electricity sector, with a shift from a centrally steered sector, towards a liberalised system where more producers enter into the market and local stakeholders and authorities are included to a larger extent (Sperling et al., 2011). For example, Copenhagen has adopted a goal of becoming the world's first CO_2 neutral capital by 2025 through cooperation and innovation (*KBH2025 Climate Plan…*, 2017), where technical solutions have to be integrated into the existing sociotechnical system amongst citizens and cultural frames. It is argued by (Minter &

Sørensen, 2018) that there is a need for furthering public-private partnerships where a broader composition of expertise as well as education of planners and developers support citizens and manage their concerns and interests. Furthermore, innovation should be driven by engagement in local needs and interests where social, environmental and economic factors are valued equally (Minter & Sørensen, 2018). This can be considered an aspect of decentralisation of power, with implications on urban energy governance. Managing the energy transition in urban space is understood as a multilevel activity, including the state, market and civil society and the processes dealt with in the study are termed urban governance. According to Kearns & Paddison (2000) urban governance is estimated by the capacity to carry out development in the light of complexity, conflict and societal change. The aim of urban governance is to distribute resources, skills and purpose with various stakeholders, where it is considered nearly as important how things are decided upon and practised relative to what is done, as efficiency and effectiveness are key factors of optimal development (Kearns & Paddison, 2000). To investigate the overall framework for urban energy governance in Greater Copenhagen, the problem analysis will further investigate the topic with focus on the process of carrying out energy projects with electricity producing facilities.

7 PROBLEM ANALYSIS

The purpose of the problem analysis is to define the problem area that forms the subsequent research. To make the research as relevant and timely as possible, the problem analysis aims to investigate current (2018) conditions for carrying out energy projects of electricity production in Greater Copenhagen. For this a stakeholder analysis is carried out. Stakeholders in energy governance in Copenhagen and what part they play in the process is considered dynamic and varying, depending on the scope of the energy project, the sector, timeframe etc. Stakeholders perceive threats and benefits in different ways and are involved in the process on different levels. Stakeholders investigated are listed in ***Table 2***.

National	Regional	Local
(The EU) from a national perspective *The Danish Parliament* *The Energy Agency* *Energinet* *The Danish Utility Regulator* *The Energy Board* *Knowledge institutions*	*Regions*	***Municipality*** ***Utility companies*** ***Citizens***

Table 2: Stakeholders deemed relevant for the problem analysis categorized according to perceived level of governance.

The stakeholders are chosen based on their perceived relevancy for the study i.e. stakeholders with influence over; the framework, choosing between alternatives or stakeholder inclusion, where key focus is on stakeholders related to local governance and how they are affected by stakeholders on state and regional level. The problem analysis is carried out to investigate official power and administrative relations, as a fundament for designing the subsequent study. The analysis is carried out through a literature study and data gathered during one site visit at an energy producing facility in Copenhagen. The analysis starts with the stakeholders on large scale, working towards local stakeholders. Background knowledge is included in textboxes when deemed helpful to illustrate the power or administrative relations. Luke's three-dimensional view on power is applied to analyse how stakeholders can influence energy projects.

7.1 ENERGY GOVERNANCE ON NATIONAL LEVEL

On this level of governance stakeholders comprise: The EU, The Danish Parliament, The Energy Agency, Energinet, The Danish Utility Regulator, The Energy Board, and knowledge institutions.

7.1.1 THE EUROPEAN UNION

The EU makes directives, regulations and decisions that affect energy governance in Denmark. EU law is decided by the EU commission and parliament. Danish interest in the EU are managed by the government, where Danish ministers have an influence on the laws passed. EU law and rules are adapted by members of the EU parliament and ministry council *(Indflydelse i EU*…, 2018). EU directives need to be incorporated in national laws and the EU commission assists in seeing it through, via online information, plans for completion, indicative documents and meetings (*Anvendelse af EU-lovgivningen*…, 2018). An example, is that Danish authorities follow up on the EIA directive of the EU. See ***Textbox 1*** adapted from *Om miljøvurderinger* (2018) and *Planloven i praksis* (2007). Examples of other EU directives include; the 'Energy Efficiency Directive' where all EU countries are required to use energy more efficiently from production to consumption with an aim of 20 percent energy efficiency by 2020 (*Energy Efficiency Directive*…, 2018), the 'Renewable Energy Directive' which establishes a policy for production and promotion of renewable energy, requiring EU countries to reach a minimum of 10 percent of renewable transport fuel and 20 percent of the total energy from renewables by 2020 (*Renewable energy directive*…, 2018).

The EU communicates values such as; global health, no poverty, sustainability etc. *(The Sustainable Development Goals*, 2018). According to the commission, cities are considered important as catalysts for creativity and innovation and are thus important for solving economic environmental and social challenges. A growing fraction of EU funded projects target integrated strategies for sustainable urban development where strong partnerships between local citizens, civil society, industry and various levels of government is advocated (*Byudvikling*…, 2018). All in all, EU can be considered an influential stakeholder affecting local energy governance in different ways. The stakeholder provides a general context in which the energy transition is carried out including overall goals and values.

Environmental Impact Assessment (EIA)

Generally, an EIA has to be made for decisions which can significantly affect the environment e.g. construction projects. The environment is a broad concept including both pollution parameters and consequences for population, human health and biological diversity. The purpose of the EIA is to provide a foundation for enlightened and environmentally sound decisions. A significant aspect of the process is public hearings before final decisions are made (Om miljøvurderinger, 2018). About half of the EIAs made in Denmark every year concern large wind turbines (*Planloven I Praksis,* 2007). *Generally, it is the municipality that is the EIA authority, but this depends on the size of the project. The outcome of the EIA and the public hearing provides prerequisites for deciding upon a project and the related requirements. throughout the work process the project is usually improved as a consequence of the EIA, both for the applicant, neighbours and for the environment. The decision is published with instructions on how to complain* (*Planloven I Praksis, 2007).*

Textbox 1: Summary of EIA. Adapted from Om miljøvurderinger (2018) and Planloven I Praksis (2007).

7.1.2 THE DANISH PARLAIMENT

The parliament passes the Acts that apply in Denmark. It is responsible for the state's budgets, approving the state's accounts (*About the Parliament*…, 2018). The parliament has three main tasks: (1) treating bills and adopting national laws, (2) treating and adopting the yearly budget of the state, the Danish Financial Act and (3) to control the exercise of governmental power. In the parliament there are 25 committees wherein law and decision proposals are treated (*Folketingets arbejde,* 2018) and the Energy Supply and Climate Committee works with energy matters. For example, they participate in international conferences e.g. hosted by the EU and FN *(Energi-, Forsynings- og Klimaudvalgets arbejde*, 2018). According to the committee multiple organisations are interested in their field and these include: interest organisations, volunteer organisations and associations, research institutions, international organisations etc. Such organisations are welcome to contact the committee should they want to inform the committee of their respective field of interest (*Energi-, Forsynings- og Klimaudvalgets arbejde*, 2018).

7.1.3 THE MINISTRY OF ENERGY SUPPLY AND CLIMATE

The Ministry of Energy Supply and Climate is the political ministry of the Energy Supply and Climate committee and administers laws for the Danish energy sector. It consist of a central department and a range of boards and companies including; The Danish Energy Agency, Energinet and The Danish Energy Regulatory Authority *(Energi-, Forsynings- og Klimaudvalgets arbejde*, 2018). This entity has the authority to define common goals, strategies and policies in the energy sector of Denmark to support governmental objectives *(Strategi og styring*, 2018).

7.1.4 THE DANISH ENERGY AGENCY

The Danish Energy Agency is a board under The Ministry of Energy Supply and Climate. It is responsible for the value chain of the energy sector i.e. production, supply and consumption, efficiency and savings as well as economy, administration and technology watch. It is responsible for ensuring that the Danish energy and supply law supports the desired development through assessments and analyses. They also administer support schemes for renewable energy *(Om Energistyrelsen*, 2018). One example of the Agency's influence is their control over the EUDP as summarized in ***Textbox 2*** adapted from (*EUDP - Energistyrelsen*, 2018), the agency chooses which projects to invest in thus shaping the future energy system in a fundamental way. Another relevant influence this stakeholder has on the processes is through its' proposed framework for socioeconomic calculations for energy projects described in *Vejledning i samfundsøkonomiske analyser på energiområdet* (2007) and summarized in ***Textbox 3***. This provides a certain standardization to the process of carrying out energy projects.

> ***EUDP (Energy Technology Development and Demonstration Programme)***
>
> *The Danish Energy Agency is responsible for the EUDP which is a demonstration program for energy technology. It is a public subsidy scheme supporting new energy technology which can help realise the Danish energy and climate goals. The strategy for 2017-2019 is to have a global focus i.e. the markets and technologies with the highest prospect of transnational commercialisation. This to further export, job creation and growth.*

Textbox 2: EUDP. Adapted from (EUDP - Energistyrelsen, 2018).

Another example of the Agency's influence over energy projects is through its' change in interpretation of the law in 2013, where the Agency started considering municipal solar PV facilities as utility companies which as a result made existing solar PV for 25 mio. DKK illegal, as municipal companies are not allowed to run utility companies (whereas the state and regions are). This has the impact that they need to offer the power on the market and purchase it back

Analytical Framework

The Danish Energy Agency offers an analytical framework for socioeconomic analyses for energy projects as one of their services. The analysis should consist of 1) Setting up a reference and alternatives including the necessary resources and alternative uses of these, and the expected consequences. 2) Socioeconomic profit measured in DKK calculated by the NPV formula where benefits and costs in a period are estimated for a basis year. The Agency highlights that where this framework falls short is when it comes to internalisation of certain social and ethical aspects. As a result, the framework is recommended to be used along other relevant consequences of energy projects including qualitative effects not possible to include in calculations, along with sensitivity calculations to make up for insecurities. As for now there is a market for CO_2 in the EU which means that this will have an influence on socioeconomic analyses. Furthermore, the method has included the welfare economic method where consequences for citizens are included in the form of values attributed to emissions of SO_2 and NO_x.

Textbox 3: Analytical framework adapted from Vejledning i samfundsøkonomiske analyser på energiområdet (2007).

with charges and VAT. This has large consequences for the municipalities. The municipality of Copenhagen has chosen to keep three facilities with a resulting operating loss of 1,2 mio. DKK in 10 years (Pedersen, 2018).

7.1.5 ENERGINET

Energinet is an independent public board under The Ministry of Energy Supply and Climate. It owns and operates the electricity and gas infrastructure in Denmark. Their main task is to increase the share of renewable energy and ensure security of supply (*Om Energinet* , 2018). Energinet needs to ensure an effective operation and equal access for all users of the grid *(Bekendtgørelse af lov om Energinet…*, 2018). Energinet ensures that the grid always delivers energy with the right frequency, and this is done by making arrangements with energy producing facilities regarding power delivery, as well as publishing a range of technical regulations with requirements for connecting to the grid and supply conditions for producing and consuming installations. Owners of solar PV facilities need to apply to Energinet for e.g. net settlement, surcharges etc. (*Proces for tilslutning…*, 2015).

7.1.6 THE DANISH UTILITY REGULATOR

The Danish Utility Regulator, is appointed by The Ministry of Energy, Supply and Climate and is independent of the government. Its' purpose is to interpret the energy laws, determining boundaries and requirements and approving pricing methods and cost. The entity supervises and analyses the energy market and publishes information to increase transparency of the energy market (*Om os: Energitilsynet*, 2018). The authority can act on cases on its' own initiative or based on a report or complaint. The Ministry of Energy, Supply and Climate determines The Danish Energy Regulatory Authority's way of handling complaints

(*Bekendtgørelse af lov om fremme af vedvarende energi*…, 2018). A key activity of this stakeholder is the regulation of utility companies, including their methods of pricing, delivery conditions. It also processes complaints about utility companies, ensuring that everyone with the necessary economy can enter into the market (*Klagesager: Energitilsynet*, 2018).

Political statement

The industry is becoming increasingly commercialised and professionalised and these stakeholders are good at carrying their own interests and sometimes at the cost of consumers e.g. in cases with large investments in failed projects and injudicious charges for energy. Thus, The Danish Utility Regulator needs to ensure that consumers are fairly treated, not paying too much for electricity gas and heat. Furthermore, long processing times propose barriers to sustainable investments. In the future there is a need of a strong utility regulator which can take on a leading role, rather than just being an administrator, to support energy efficiency, technological development and a cost-effective energy transition. Every year the supply sector has a turnover of about 80 mio. DKK a year where a Danish household consumes about 37,000 DKK a year on water, heat, electricity and tele. In September 2016 the government presented the first supply strategy in Danish history, where a goal of providing Danish households with 2800 DKK more a year in 2025, and this is to be achieved by administering energy prices, increased competition and better oversight over processes. The Danish Utility Regulator will be provided with sufficient data to be able to supervise and control that laws and regulations are complied with and that energy companies are run effectively for the benefit of the consumer.

Textbox 4: Political statement adapted from Forbrugerne skal i centrum… (2017).

The ***Textbox 4*** adapted from *Forbrugerne skal i centrum*… (2017) represents a change in framework for the Danish Utility Regulator, where there is a redistribution of power, in this case in favour of the citizens.

7.1.7 THE ENERGY BOARD

The Energy Board is a board below the Ministry of Industry, Business and Financial Affairs. It is the supreme appeal body for decisions made by energy authorities i.e. The Danish Energy Agency, The Danish Energy Regulatory Authority, Energinet and the municipalities. The purpose of the board is to offer professional and juristic assistance to stakeholders (*Energiklagenævnet*, 2018). Verdicts made by the board are finite. Everyone with significant and individual interest in environmental aspects of the decision can send a written complaint to the Energy Board (*Bekendtgørelse af lov om fremme af vedvarende energi*…, 2018). The Energy Board is part of 'Nævnenes Hus' which strives to solve conflicts between citizens, business and authorities in cases related to; business, consumption, health, environment and energy. The fundamental principle is that everyone has equal access to legislation *(Om Nævnenes Hus*, 2018). The Energy Board then gathers relevant information and decides upon the outcome of the case. Typical cases concern surcharges or permits in compliance with law on furthering renewable energy. Cases can also concern energy labelling in compliance with law on furthering energy savings, approval of collective heat supply projects in compliance with law on heat supply etc. (*Klagevejledning Energiklagenævnet*, 2018).

7.1.8 KNOWLEDGE INSTITUTIONS

Knowledge institutions are in this study defined as stakeholders with scientific perspective upon energy processes, possessing significant knowledge resources. Contribution can be in the form of knowledge and analysis of single projects or system optimisation, spanning across fields. In this category; universities, NGOs, media etc. are included, resulting in a broad stakeholder group.

NGOs are considered relevant to energy transition. An example, is The Danish PV Association, which is summarized in ***Textbox 5*** adapted from *Om foreningen - Dansk Solcelleforening* (2018). NGOs are expected to advocate certain topics. They don't need to distribute resources between multiple sectors or accommodate multiple stakeholders, and if they gain enough power e.g. by developing a large network of stakeholders, they might be able through lobbying to affect policies in favour of their field. Knowledge institutions can help non-experts navigate complex process e.g. putting up solar PV. Other examples are universities providing scientific contribution to fields, media which can spark a debate over a topic, and inform the general population of issues, which in turn can influence politicians etc. It is a broad category, deemed important for stakeholder inclusion.

The Danish PV Association

The association is an organisation for companies. The members are other NGOs, manufacturers and importers and traders of PV products. Furthermore, members include counsellors, architects, designers and engineers. They put political focus on the business and work for better framework conditions for the companies and further the PV activities in Denmark. They provide services such as overview over general information on PV, relevant legislation, news sharing, etc.

Textbox 5: The Danish PV Association. Adapted from (Om foreningen - Dansk Solcelleforening, 2018).

7.2 ENERGY GOVERNANCE ON REGIONAL LEVEL

Having looked at the stakeholders on state level, regions are now included.

7.2.1 REGIONS

Regions develop strategic visions concerning; nature, environment, business, employment, education and culture. The vision is considered a mutual project for municipalities, businesses, the regional council and other stakeholders in the region. The municipal plans cannot go against the regional development plan (*Planloven i praksis*, 2007). The regions work with energy and climate aims for regional growth and development strategies. It concerns topics like cooperation between municipalities regarding strategic municipal planning, local Agenda21[1] strategies and public transportation. Strategic energy planning is defined by the Danish Energy Agency as a central aim where the agency provides guidelines and funding for strategic energy projects (*Strategisk energiplanlægning i kommunerne*… 2018). The concept is summarized in ***Textbox 6*** adapted from *Strategisk Energiplanlægning på Kommunalt og Regionalt Niveau* (2016).

Strategic Energy Planning (SEP)

Strategic energy planning promotes partnerships and planning between municipalities, local business and energy companies, to improve the correlation between the state, region and municipal initiatives and to support citizen participation. The SEP approach is long term and holistic. It strives for an economic green transition through reducing end-use demand, increased energy efficiency and transition in central CHP areas, in other district heating and individually heated areas and in the transport sector. Furthermore, partnership structures focus on carrying out analyses of a combined energy transition, optimal use of renewable energy and surplus heat and increased flexibility in the system. According to the source, strategic energy planning has furthered insight into the various stakeholders interests and competences. It has improved the stakeholders knowledge of each other and the overview of the combined energy system and thus created a platform for future work to be built upon.

Municipalities decide whether they want to pursue SEP e.g. how often to carry out a holistic estimation of the local infrastructure rather than pursuing a project-based process where projects are processed individually. Furthermore, there is no demand for cooperation between municipalities on energy matters.

Textbox 6: Strategic Energy Planning. Adapted from Strategisk Energiplanlægning på Kommunalt og Regionalt Niveau (2016).

Regions focus on synergies across municipal boundaries and on optimising the energy system on a larger scale, rather than having particular local interests which can be expected for e.g. the municipalities *(Danske Regioner*…, 2018). Regions provide guidance for municipalities in order to further strategic energy planning which is deemed important to a renewable energy transition in a societal and energy efficient way (*Danske Regioner*, 2018). Regions are arguably an important stakeholder as they provide a link between national and local actors.

[1] *Agenda 21 strategies typically concern sustainable solutions for decreasing pollution levels and resource consumption e.g. by changing consumption patterns (Agenda 21 | Gyldendal - Den Store Danske, 2017).*

Energy Across (Energi på Tværs)

Energy Across is an example of a strategic energy project. It is a project where municipalities and large utility companies in the Capital Region have formed a partnership to develop a common vision for energy and transport and to implement strategies for cooperation. The goal, decided by the mayors, is to be fossil fuel free in the electricity and heating sector by 2035 and in 2050 for transportation (Strategisk Energiplanlægning på Kommunalt og Regionalt Niveau, 2016). The project is run by the partner organisation Gate 21 which has a goal of accelerating the green transition. Energy Across is financed by The Energy Agency, The Capital Region, energy companies and the included municipalities. The purpose of the project is to coordinate energy vision across municipalities to guide political decisions on large investments as well as creating the overall framework for strategic planning in municipalities. The project forms a common platform for communication between stakeholders and furthers cooperation and new project suggestions across municipalities and energy companies in the private sector (Baggrund | Energi På Tværs, 2018).

Textbox 7: Summary of Energy Across. Adapted from (Strategisk Energiplanlægning på Kommunalt og Regionalt Niveau, 2016) and (Baggrund - Energi På Tværs, 2018).

In ***Textbox 7*** an example of strategic energy planning relevant for Greater Copenhagen is summarized adapted from *Strategisk Energiplanlægning på Kommunalt og Regionalt Niveau* (2016) and *Baggrund - Energi På Tværs* (2018).

Strategic energy planning is arguably relevant in Greater Copenhagen, since in the Capital Region there is a coherent habitat and work environment as well as common regional recreational areas across municipalities and therefore, planning in the Capital Region is different than in other places in the country. See ***Textbox 8*** adapted from *Planloven i praksis* (2007). Arguably this entails cooperation amongst the municipalities in the region to a greater extent than for other regions.

Greater Copenhagen

Greater Copenhagen is split into four categories: (1) the central city area, where development and conversion happens within existing city zones, (2) the city fingers which is the outer metropolitan area where city development and functions are placed in regards to existing infrastructure (3) the green areas between the city fingers which are not to be used for city or recreational purposes and (4) the other metropolitan areas spread across the capital region where development is local of character.

Textbox 8: Planning in Greater Copenhagen. Adapted from Planloven i praksis (2007).

7.3 ENERGY GOVERNANCE ON LOCAL LEVEL

Having looked at the stakeholders on state and regional level, local stakeholders related to Greater Copenhagen are now considered. The stakeholders include; The Municipality, utility companies and citizens.

7.3.1 THE MUNICIPALITY

The municipality needs to comply with upper rules and regulations as well as interests on local level and is responsible for the physical planning and development in cities and landscapes. It is on this level of governance that overall political goals are concretised. The municipality makes a political strategy which constitutes the framework for planning and project management, and large buildings and constructions cannot be carried out before the local plans have been adopted. Often municipalities combine policy areas such as business development, culture and health in order to create coherence and legitimacy for their strategy (*Planloven i praksis*, 2007) meaning that municipalities will end up with visions highly adapted to local circumstances.

The power of the municipality varies depending on the project. For example, municipalities already own or maintain public buildings and therefore can implement energy savings relatively easily compared to savings in private buildings. Some municipalities approach the issue by developing partnerships with entrepreneurs and credit banks to offer package solutions for private building owners. A key obstacle however, are the economic circumstances. Several sector budgets depend on state funding which usually does not allow for many "extra" investments and thus the municipalities are financially limited. However, as seen in some of the governmental stakeholders, funding can be sought after if a project is deemed suitable and in line with overall state goals (Sperling et al., 2011).

Regarding strategic energy planning, Sperling et al. (2011) found that whilst there is a general willingness among Danish municipalities to engage in strategic energy planning, there is a lack of a concrete national strategy for this and thus the role of the municipalities is not altogether clear. Municipal plans lack a level of detail to ensure an integrated 100 percent renewable energy system and that municipalities understand their role in energy planning and aspects of the energy system differently (Sperling et al., 2011). This provides an understanding that although the municipalities have the option to pursue strategic energy planning, there likely is not sufficient framework for this. Along with ***Textbox 6*** from previous section the implication that the strategic energy planning is a continuous learning process is clear. The municipality is expected to be involved in all local energy projects. For example, EnergyLab Nordhavn is an example of a project where the municipality is a partner summarized in ***Textbox 9*** adapted from *EnergyLab Nordhavn fremtidens energi system* (2018). It illustrates a project based in

EnergyLab Nordhavn

EnergyLab is a project spanning from 2015-2019, with efforts directed at new urban energy infrastructures. For this Nordhavn, a city district in Copenhagen, is utilised as a full-scale smart city energy lab to demonstrate future energy solutions aiming at a flexible, intelligent and optimal energy system. Demonstration projects include how electricity and heating, energy-efficient buildings and electric transport can be integrated in urban space. Amongst others the partners include DTU, The municipality of Copenhagen, CPH City & Port Development, HOFOR, Radius, ABB, Danfoss. The project is supported by EUDP.

Textbox 9: EnergyLab Nordhavn adapted from EnergyLab Nordhavn fremtidens energi system (2018).

Copenhagen spanning over levels of governance and with the aspect of Copenhagen as a front runner of the transition, testing new urban energy infrastructures.

7.3.2 UTILITY COMPANIES

Utility companies are subject to laws and regulations. In Denmark there is an open electricity market, where in theory everyone has free access to the electricity grid, which means that there are multiple stakeholders comprising the market. Stakeholders can vary from e.g. Ørsted where the CEO in 2014 was deemed amongst top 25 most powerful business people in Denmark with an ability to influence the development of the Danish society (Kjær, 2014), down to individual Danish citizens who want to become energy producers. For example, if a private stakeholder wants to install a PV facility larger than 1,5 MW he will become an energy producer and redefine his role in the electricity grid (*Proces for tilslutning…*, 2015). It is the responsibility of the PV owner to ensure that the facility is correctly installed, to fulfil technical requirements and to apply for surcharge and net settlement. This is done through cooperation with Energinet and the local distributor. Energinet approves the facility and the local distributor acts as middleman ensuring that relevant conditions are met. The Danish PV association has made a guide for this guiding new actors through the process (*Proces for tilslutning…*, 2015).

Case: Copenhagen International School (CIS)

CIS campus is designed as a sustainable and innovative space for international students. It is 25,000 m^2 and hosts close to 1,000 students, mostly children of employees at international organisations and companies e.g. UN City. These types of expert employees are important for European capitals which compete in recruiting them. Providing a good school is an important aspect of attracting this workforce and compelling it to stay.

Nordhavn is a special district in Copenhagen where architecture and environment differs from the rest of Copenhagen. It is a wealthy neighbourhood where apartments are expensive and architecturally unique as most of the existing harbour constructions have been preserved. Therefore, the inhabitants are generally wealthy with high expectations for their school.

CIS brands itself with its high performance regarding sustainability. It is the most expensive school ever built in Denmark and has cost 655 mio. DKK payed mainly by funds. Sustainable initiatives include: LED lights, smart control over the energy use in the building along with sustainable materials and green roofs. The horizontal facade of the school comprises 12,000 solar PVs which produce almost half of the school's electricity, the equivalent of 70 one-family houses. Furthermore, bio waste is collected, grinded and sent to a biogas producing facility. The school is so energy efficient that there is more energy spent on cooling and ventilation than lighting and heat. The school integrates sustainability in teachings. The data from the PVs is analysed by the students and other aspects of sustainability behaviour is taught e.g. energy behaviour, waste assortment, recycling, organic farming etc.

…The CIS case continues in ***Textbox 11***

Textbox 10: The researcher met with the director of communications and advancement at CIS; Thomas Nielsen and was given a tour at the site. The summary is approved by Nielsen post the visit.

Another way of being involved in energy production in Denmark is through the purchase of a share of a project. For example, the law states that 20 percent of a new wind turbine needs to be offered to neighbours of the turbine within a radius of 4,5 km first. Second, the rest of the population in the municipality are offered to purchase the remaining part of the share. The erector of the turbine needs to make this announcement in local newspapers and offer information for interested parties (*Danmarks Vindmølleforening*…, 2018). As energy projects differ significantly, the case of Copenhagen International School (CIS) is chosen as an example. The case of CIS illustrates how a new project can take form in a way which is deemed fitting for urban space. The case is summarized in ***Textbox 10*** and ***Textbox 11***.

…The CIS case continued from ***Textbox 10***

In the creation of the school, there have been conflicts regarding the architecture of the building versus its' functionality. It was not originally designed to be fitted with solar panels, and there was some resistance towards this from the architects because of the visual implications. However, the decision to use the solar panels was supported by the location of the school in a sustainable and innovative district in Copenhagen and PVs fitted well into this picture. The PVs are mounted on the vertical facade because the roof is used for other purposes, e.g. playgrounds, greenhouses, etc. The panels can produce energy on diffuse light. They are angled individually to create the aesthetical effect of varying shades of blue and green. This has had implications for the energy production of the PVs. There is the issue of shadow effect, where the building structure and people hinder the energy production from certain panels at times. This has been mitigated by installing microinverters for clusters of panels to stabilise the production, so that even if some panels stop producing it does not affect the production of the remaining panels. Furthermore, the facility produces most energy during spring and fall because of the angle of the sun in these months. This production pattern fits well with the energy need of the building as it is not used much during the summer. The school rarely produces more electricity than it spends. CIS has not been permitted to sell electricity on the market, and instead the school offers the residual production for free. This is due to legislation that does not allow non-profit organisations to earn on energy production. There might be a potential for cooperating with neighbouring institutions with other energy use patterns to balance production and consumption. In the future the potential for battery solutions is also considered. The hope is that in the future energy symbiosis could be formed on non-monetary basis, where production and consumption is balanced locally.

Textbox 11: The researcher met with the director of communications and advancement at CIS; Thomas Nielsen, and was given a tour at the site. The summary was approved by Nielsen post the visit.

CIS represents a case of new actors entering into the energy market. It is an example of a stakeholder which is willing, and has the means, to brand itself with sustainability. It can be argued that the CIS case is not optimal from an energy perspective. If the energy production was thought into the design of the building from the beginning its' performance could have been optimized. Instead it has become a non-organised process which has been further challenged by legislation. This can be translated into a lack of cooperation between involved stakeholders and a need to define a common strategy across professions. Despite all these factors the project was integrated into Nordhavn, a city part known for its' expertise and resources in the field of sustainability and renewable energy.

7.3.3 CITIZENS

Because of the economic recession and budget cuts, improvement of the civil services and de-centralisation of public tasks, citizens today are expected to be more self-sufficient. Citizens take over activities which were formerly public services and often citizens are invited by their local government and in general overall visions to participate in governmental and authoritative tasks (*Prospects for e-democracy…*, 2018). *Textbox 12* adabted from Berry et al. (2011) and Kyriakopoulos (2011) summarizes some arguments for public participation found by scientific studies. Public inclusion is also an aim in Denmark, where Danish legislation states, that citizens should be included in the planning process on municipal, regional and national level and the minimum requirement is that citizens have the right to make an opposition e.g. to governmental statements and directives in hearings (*Planloven i praksis*, 2007). One example of a project where citizens played a large part was the ECO-life project summarized in *Textbox 13* adapted from *ECO-Life-Sustainable Zero Carbon …* (*2016*).

Arguments for Public participation

Studies have acknowledged the benefits of public participation. By increasing public participation as well as the access to information, the public can be empowered, and transparency and legitimacy of processes can be improved. Moreover, it has shown a potential to speed up decision making, especially if citizens are involved early in the project. It is recognised at local, regional and governmental levels and many policies exist to increase public participation in environmental planning groups (Berry et al., 2011). Deployment during construction, rental income for landowners, the site as a possible tourist attraction, less electricity charges for those living nearby and the possibility for consumers to donate to additional local projects, enables a local area to prosper on energy projects and to include the general population in the green transition (Kyriakopoulos, 2011).

Textbox 12: Arguments for public participation. Adabted from (Berry et al., 2011), Kyriakopoulos (2011).

ECO-Life: A Citizen centered project

The ECO-Life project spanned from 2009-2016 with the aim to improve the quality of life across the EU and was co-funded by the EU. It comprised of demonstration of energy efficient buildings and integration of renewable energy sources and Høje Taastrup, in Greater Copenhagen was one of the cases for this project. The project included refurbishment and construction of houses with high energy efficiency standards as well as instalment of renewable energy systems such as rooftop mounted solar PV, heat pumps, solar thermal systems etc. The central goal of the project was to combine energy efficiency with use of renewable sources as well as the introduction of innovative solutions for involvement and engagement of citizens. The project resulted in; refurbishment of more than 16,000 m², construction of more than 8,000 m² low energy buildings and installation of renewable energy systems, producing 1,970 MWh in 2015. Citizen interaction was practised through discussions and co-development of solutions. There was much focus on modifying behaviour to ensure energy efficiency and for sustainable energy projects to succeed and citizens were educated about appropriate energy behaviour.

Textbox 13: ECO-Life: A Citizen centered project. Adapted from ECO-Life-Sustainable Zero Carbon…(2016).

Other general citizen inclusion initiatives include; sending out material for debate, public meetings, workgroups, electronic city panels etc. which are up to municipalities to experiment with (*Planloven i praksis*, 2007). For example, *Energiplan 2025…* (2015) clarifies that the Capital Region strives towards green growth and innovation through increase public-private partnerships in the energy sector and furthering green innovation (*Energiplan 2025…*, 2015) indicating that citizen inclusion is of high priority in Denmark.

7.4 LUKE'S THREE-DIMENSIONAL VIEW ON POWER

The stakeholders deemed valuable to the study are analysed in the context of Luke's three-dimensional view on power in the following. Luke operates with power across three dimensions, which assists in structuring studies of power in a planning context (Schmidt-Thomé & Mäntysalo, 2014).

The first dimension is measured by the power to prevail in decision making situations e.g. through resources or authority (Lukes, 2005). The one-dimensional view is where power is estimated by looking into actual decision processes. It is a simple matter of examining how some stakeholders are able to push through some decisions which other stakeholders oppose, where this dimension has an observable conflict with a behavioural focus (Schmidt-Thomé & Mäntysalo, 2014).

The second dimension is measured in the control over agenda i.e. the control over alternatives discussed (Lukes, 2005). It is the power to keep some things out of the decision-making agenda or public debate. It can also be termed manipulative power where the alertness of aspects, alternatives etc. is withheld from stakeholders by using misinformation (Schmidt-Thomé & Mäntysalo, 2014).

The third dimension is measured in control of consciousness through manipulation of thoughts e.g. choice over what values and information is communicated thus influencing what is believed and desired by other stakeholders (Lukes, 2005). This dimension ads depth to indirect power and concerns structural influence. When stakeholders comply willingly it can be understood as third dimensional power, in the form of compliance to domination. Even if stakeholders do not resist domination they might still have interests which are harmed through compliance (Schmidt-Thomé & Mäntysalo, 2014). It is often taken for granted that some issues and processed are favoured over others, shaped by deep conditions of societal and cultural habits, and institutional settings, and applying a third dimension to power in analysis can help create awareness of this (Schmidt-Thomé & Mäntysalo, 2014).

Luke's view in power is applied to assist in understanding how power is distributed amongst stakeholders in the following.

7.4.1 POWER ON NATIONAL LEVEL

Stakeholders on state level are generally seen to practise first dimensional power through monetary, knowledge and legislative resources which directly affect other stakeholder's activities. For example, EU can choose to finance projects that fit EU goals, ensure their scalability and/or transferability across EU countries such as has been seen with the ECO-Life project (see *Textbox 13*) where monetary support helped realise the project. Another example of one-dimensional power is when the Danish Energy Agency is able to change the legislative conditions for solar PVs significantly and thus control involved stakeholders.

When analysing the stakeholders practising second-dimensional power, the services that the stakeholders provide can be considered. Through services, stakeholders can determine what information is given and what is left out. Authorities with resources to provide such services as well as a large platform to gather many stakeholders can thus become powerful. An example of this is the published guidance as to how alternatives are estimated by the Energy Agency (see ***Textbox 3***) concerning which values should shape the process of carrying out an energy project. Such practise of power can exclude some alternatives which would have been included with another measure for estimating the consequences, for example in terms of internalisation of additional externalities.

Stakeholders practising third-dimensional power represent the ideological context in which discussion and decisions are carried out. Authorities have significant power when it comes to shaping the overall path of sustainable development through defining values and goals to be pursued such as the aim of strategic energy planning seen in ***Textbox 6***. Moreover, third dimensional power can be seen when considering the values communicated by the EU i.e. global health, no poverty, sustainability etc. These values shape the manner in which sustainable energy is discussed throughout the levels of governance, where for example the ECO-Life project is carried out in the context of values and aims of the EU. This is also something seen in the knowledge institutions and organisations and depending on the size of their network, they might be able to influence the values communicated and debated.

7.4.2 POWER ON LOCAL LEVEL

Whilst still being subject to national authority, the first dimension of power can also be applied to local stakeholders. The municipality has the authority to carry out the physical planning in an area, with knowledge, money and legal resources they possess direct power in a variety of processes. Although they might be somewhat limited economically within some sectors, they are able to activate resources to affect processes directly. This is for example evident when the Municipality of Copenhagen chooses to continuously invest in rooftop mounted solar PV. Even though law complicates it, they pursue this alternative to reach an ambitious climate goal. Utility companies can also be argued to possess direct power, as they have a technical knowledge and make investments in energy projects choosing between alternatives. Citizens have the opportunity to become energy producers by e.g. investing in rooftop mounted solar

PV, although they are not considered a powerful stakeholder individually, authorities on various levels recognizes their importance for the green energy transition. An example is seen where citizens power has been strengthened by The Danish Utility Regulator and The Energy Board by providing citizens with legislative power.

When considering two-dimensional power, processes can be expected to be shaped by conditions in a local area i.e. what is already implemented, existing resources, demography, local expertise etc. so for example if new energy projects were to be carried out in Høje Taastrup they would likely be influenced by the concluded ECO-Life project. Local stakeholders, if they have a large network or other considerable resources, are likely to influence local projects. For example, if a project is expected to increase local growth this is expected to be prioritized, and large utility companies and other stakeholders have the power to see to this. An example is the CIS case, where there is considerable funding which allows for a project of such dimensions and certain characteristics even though it can be considered suboptimal from an energy perspective.

Regarding the third-dimension, values communicated on the local level, are likely different in nature compared to state values but local stakeholders can still be attributed third-dimensional power. A municipality can be expected to communicate certain values e.g. job creation, natural or cultural values etc. which are more so reflected in the local conditions. Utility companies, and citizens can also practise power through communication of values depending on the demography of an area, and depending on the size of their network, stakeholders can gain considerable power this way.

With a general understanding of power and administrative relations, it can be concluded that power is a key aspect of the energy transition, shaping the processes of carrying out energy projects. Power is a complex size where all three power dimensions are practised in Greater Copenhagen. Moreover, power can be re-disturbed amongst the stakeholders and the decentralisation of power and ongoing urbanisation are tendencies supporting this. To gain a better understanding of the changing power relations within the energy sector and the barriers and opportunities these pose, advances within digitalization and the internet are examined in the following.

7.5 DIGITILIZATION AND THE INTERNET

Planning has become highly digitalized in Denmark, where most municipalities work with digital plans (*Planloven i praksis*, 2007). Moreover, the UN has estimated that amongst member countries, Denmark is the best when it comes to digitalization within the public sector, well balanced between effective public digitalization and the possibility of helping the individual citizen in person. Both citizens and businesses in Denmark have adopted the digital services (*Danmark er blevet …*, 2018). In general, the internet has provided multiple opportunities when it comes to stakeholder inclusion and cooperation. E-participation is expanding globally and can be categorised into three levels: **1)** E-information **2)** e-consultation and **3)** e-decision making/e-democracy. These have been examined in a report by the EU parliament, stressing that e-democracy is a large focus today and refers to multiple practises of online engagement in political decision making and opinion forming (*Prospects for e-democracy in Europe …*, 2018). The drivers for e-participation is an increased digitalization, development of digital tools, social media and growing access to the internet. There has been rising interest in citizen involvement in policy making where citizens themselves want to be more involved and seek more power. E-participation provides opportunities for this. Especially in Europe e-participation has empowered citizens within politics and governance (*Prospects for e-democracy in Europe …*, 2018). The main achievement of e-democracy has been improved access and exchange of information supporting the public debate. It has improved communication between citizens and governments with better and faster accessed information and has enabled various procedures. In late social media has emerged as a new form of access and communication and also this provides new possibilities for citizens (*Prospects for e-democracy in Europe …*, 2018) and spatial planning as well. An approach which has become popular is the use of a website where the plan is digitalized in a map that enables users to comment or object on the website. This is especially popular method as a way of including citizens in a convenient way (Simão et al., 2009). A common system has been established in Denmark called 'PlansystemDK' containing local plans, municipal planning framework and a zone map, where users can access both active suggestions and decided local plans and municipal plans (*Planloven i praksis*, 2007). Thus, geographic attributes are now clearly defined and presented in maps. Moreover, the Environmental Portal (Miljøportalen) offers free updated public data on nature and environment for download, with the goal of furthering digital management of the environment (*Planloven i praksis*, 2007). These options can be described as e-information, where planning information is made available to the public. An example of an attempt to further e-democracy in Denmark is the TIMES-DK interface summarised in ***Textbox 14*** adapted from Wittrup (2018) and *Om Værktøjet* (2018) which is currently under development, indicating a recognition of the potential for e-democracy.

Despite the high potential for e-participation when it comes to public inclusion, it is estimated by *Prospects for e-democracy in Europe …*(2018) that public participation is mostly limited to the initial and final stage of a policy process and citizens are seldomly included in central stages of decision making and policy execution. This is a relevant issue to look into as stated by the report, citizens have more opportunity than ever to be heard by the authorities due to development within e-participation, and when this is not realised the disapproval of the citizens is prevalent. This indicates that in spite of citizens getting a voice authorities might not know how to act upon it yet (*Prospects for e-democracy in Europe …*, 2018). According to Minter & Sørensen (2018) easy access to social media has provided an efficient platform for oppositions to energy projects, compromising a constructive dialogue. This has for example been experienced with wind turbine projects in Denmark, where Minter & Sørensen (2018) argues that it is often the feeling of decoupling and exclusion that motivate citizens for turning to social media and the debate risks becoming asymmetrical i.e. oppositions to projects becomes strong whereas supporters typically are more silent. This tendency is made worse by the fact that few authorities use social media as a communication forum, resulting in a discrepancy between where the authorities and citizens are present (Minter & Sørensen, 2018).

The TIMES-DK user-friendly interface

A research group at DTU is developing a user-friendly energy model tool of the TIMES tool (a technical economic optimisation model covering all energy sectors in Denmark). The model can illuminate goals and policies across the energy sectors (electricity, district heating, buildings, industry and transport). Currently the TIMES model is used by the Energy Agency, energy consultants and DTU, but the goal is to open for a broad scope of actors which can test their vision and initiatives in an optimisation model. The tool allows for defining and interpreting results in regard to the energy system. The group is currently working on developing a web interface version of the TIMES model and they expect that it will be up and running during the fall of 2018 (Wittrup, 2018). The next step is to develop a web-based tool where users are able to change the prerequisites themselves and see the results right away. Moreover, the aim is to open access to all models and data (Om Værktøjet, 2018).

Textbox 14: Summary the TIMES-DK user-friendly interface Adapted from Wittrup, (2018) and (Om Værktøjet, (2018).

There are indicators that Danish stakeholders are starting to see the opportunities for tapping into e-democracy. It can be considered beneficial for an area like Greater Copenhagen which has distinguished itself with; an ambitious climate goal, a goal of public inclusion and a high level of digitalization. Furthermore, there is arguably a need to actively try and prevent negative effects that digitalisation and the internet pose, by using it actively to improve e-democracy.

7.6 RESULTS

The results of the problem analysis are summarized in ***Table 3***, where the focus is on local projects related to electricity production in Greater Copenhagen.

State and Regional	Local
A continuous redistribution of power is reflected on state and regional level where the interchangeable framework for PV production is an example. Through redistribution of power tasks have been attributed different stakeholders. Power is practised on all dimensions through monetary, legislative and knowledge resources, choice between alternatives and communication of values.	*Local planning and management in Denmark is somewhat detached from the state planning through the decentralisation process. Whereas the state provides the overall framework and funding, local authorities are trusted with physical planning and development tasks that should be strategic and include the local population. The current approach to strategic energy planning is somewhat non- structured as there is not a well-defined framework for what it entails.*

Table 3: Results from the problem analysis.

The problem analysis is broad of scope and arguably inadequate in encompassing all factors and dynamics in the Danish electricity sector and its' changing power relations. It is furthermore an immediate picture, where conditions, stakeholders and their power can be expected to change. However, within the scope of the study, the problem analysis is considered adequate. The analysis has provided an overview of the situation in 2018. It has provided a basis for designing the following research according to knowledge gained of power and administrative relations of the involved stakeholders, where e-democracy is argued as an important aspect of the future energy transition.

8 PROBLEM STATEMENT

Working with the consensus that decentralisation and urbanisation in combination with advances within digitalization and the internet, provide opportunities for redistributing power relations in favour of the energy transition, the study will investigate the potential for e-democracy for energy governance in Greater Copenhagen. This arguably provides a context and a rationale for proposing a web-based platform as a measure to integrate stakeholders and further cooperation locally.

8.1 RESEARCH QUESTION

To analyse how to develop a platform concept for integrating e-democracy into energy governance in Greater Copenhagen, following research question is asked:

How can a web-based platform be designed to assist in integrating stakeholders and organise cooperation in renewable electricity projects in Greater Copenhagen?

To answer this question following sub questions are investigated:

I. *What are the barriers to include stakeholders and structure cooperation?*

II. *Which elements and functions should be integrated into the platform to accommodate these?*

The research question is asked to support the role of Greater Copenhagen as an innovative forth runner in the energy transition in terms of stakeholder inclusion and cooperation, where the practical world of planning, politics, administration and citizens is considered. This is done by analysing and proposing a platform concept, which is sufficiently flexible to be relevant for a variety of energy projects. The first question is asked to clarify potentials and barriers in stakeholder inclusion and cooperation, to develop a basis on which to carry on designing a platform concept to answer the second question.

8.2 SCOPE OF PROJECT

The geographic extent of the study is Greater Copenhagen. This is to include relevant energy infrastructure and stakeholders in the area, and to accommodate aims of strategic energy planning, which is an inclusive approach with focus on cross-municipal solutions. The focus will be on projects regarding electricity producing facilities and the processes in which they are implemented with emphasis on stakeholder integration and cooperation. This is deemed relevant as it is the potential for e-democracy which is analysed, where stakeholder integration and cooperation is central, also for technical optimisation.

9 THEORETICAL FRAMEWORK AND RESEARCH DESIGN

In this chapter the selected theories are explained. These include Transition Management theory and Strategic Niche Management theory. The theory presentations will be followed by the methods. These include; a study of literature, interviews and spatial analyses. Lastly the Design Thinking approach is used to structure the research.

9.1 TRANSITION MANAGEMENT THEORY (TM)

Transition Management theory is used to define guidelines for green energy projects. It is a framework concerning abstract governance systems, regarding how to manage sustainable sociotechnical transitions optimally by merging short and long-term processes on various levels. In doing so, four types of governance are defined: Strategic, tactical, operational and reflexive, which are deemed necessary for optimizing sociotechnical transitions (Kemp et al., 2009).

Strategic: On this level long term visions and goals are defined and specified (Loorbach, 2010). A central aim is the integration of long term planning into short term political cycles (Kemp et al., 2009). Processes on this level are long term of about 30 years (Loorbach, 2010).

Tactical: On this level tactics for reaching the overall visions and goals are established in sociotechnical subsystems i.e. patterns and structures such as rules and regulation, and concerns institutions, organizations, networks infrastructures and routines. Processes on this level are midterm of about 10-15 years (Loorbach, 2010).

Operational: On this level practices are established, mainly on a local scale as operational activities, experiments and actions, often carried out in the context of innovation. This is done by introducing structures, culture, routines or actors often over short timeframe of about 0-5 years (Loorbach, 2010).

Reflective: On this level learning effect ensures transparency and prevents lock in to suboptimal paths. This is done by monitoring, assessing and evaluating through; scientific contribution, responsible entities and actors, media topics. Processes on this level are continuous (Loorbach, 2010).

An optimal transition should unfold on all the levels of governance with coordination between governance types (Loorbach, 2010). TM helps integrate a more dynamic and circular approach with a continuous learning process. It can be used to argue for increased participation and information sharing across levels of governance and to argue for development of networks which include many different stakeholders as well as coordinating processes across levels of governance. The guidelines set up by TM will be applied in the interview analysis of the Municipality of Copenhagen to identify barriers in current governance processes.

9.2 STRATEGIC NICHE MANAGEMENT THEORY (SNM)

Creating a platform can be considered an innovative way to practise urban governance as it is an alternative to a dominant practise with a potential to scale up and replace existing processes and structures. It is considered important to carry out innovation projects, so they can act as building blocks for societal change towards sustainable development (Schot & Geels, 2008). Based on this SNM is used to set up guidelines for a successful innovation. For SNM five factors are understood as significant:

Expectations and visions: Having a clear definition of expectations and visions shared by multiple stakeholders offers a direction to the innovation and attracts attention. It legitimates (continuous) protection and nurturing of the innovation (Schot & Geels, 2008).

Learning: Ensuring broad learning effect of multiple dimensions with accumulation of data and facts, as well as ensuring facilitation of changes in the cognitive frames and assumptions surrounding a project i.e. second order learning (Schot & Geels, 2008).

Networks: Including many different actors with possibility to mobilise resources and commitment in other networks and organisations. It ensures diverse viewpoints and experiences (Schot & Geels, 2008).

Protected space: Creating protected spaces where experimentation can be carried out in a way that ensures co-evolution of technology, user-practises and regulatory structures. This can enable development of the project until it is ready for market penetration (Schot & Geels, 2008).

Niche-regime interaction: Innovation will have to fit well with the received context. Taking a multilevel approach that ensures that the project is relevant in providing solutions or functions otherwise missing in the sociotechnical regime (Schot & Geels, 2008).

The guidelines of SNM are applied in designing the platform, to increase the potential for the platform concept to act as a building block towards optimising the energy transition. It is thus considered viable that the platform is designed by integrating the guidelines of the SNM theory.

9.3 DATA COLLECTION METHOD

Data are applied to carry out the analysis in the study. These include the BBR register and the Heat Atlas. These two datasets were accessed via Aalborg University. The BBR register is the Danish building and dwelling register. It contains information on building and residential data i.e. area, location, use, installations, roof material, building age etc. and is in shape format *(Om BBR*, 2018). The heat atlas is data over heat consumption in MWh per year in shape format. It contains assumed heat consumption based on building type, size and age and is thus not measures data, (*The Danish Heat Atlas*, 2016). In addition, two datasets were downloaded from Kortforsyningen (Map Supply): An elevation map and a map of basic topographic data. The elevation map (DHM surface) has detailed information on elevation conditions in Denmark in 0,4 m grid raster format (*Danmarks Højdemodel*, 2018). The map of basic topographic data (GeoDenmark-data), includes buildings in shape format (*GeoDanmark…*, 2018). Qualitative data are gained through interviews, where the interviews are recorded, summarized and made available in the online appendix: Online Appendix. Moreover, the analyses of the study are supported by literature, primarily in the form of scientific texts, articles and legal frameworks where the agenda of the author is considered for each source to ensure legitimacy of the information.

9.4 INTERVIEWS

Elite interviews are carried out where informants are leaders or experts in the field of renewable energy. The interview analyses are supported by TM and SNM to provide context to the theories. TM is used to locate barriers to the energy transition with focus on stakeholder inclusion and cooperation. SNM is applied in designing the platform concept, which is used in the analysis of the subsequent interviews. The researcher steers the interviews to ensure a useful outcome. The informants are chosen amongst key stakeholders found viable through the problem analysis. They all work in an environment, where it is necessary to think innovative solutions into existing processes. Because of this they can provide helpful suggestions for designing the platform. The informants have experience with stakeholder inclusion and cooperation and are considered reliable in their experience hereof. Material is developed and sent to the informants before the interviews and an interview guide is made for each informant to ensure the relevancy of the information. The interview structure leaves room for informants to speak freely about the topic, to generate innovative ideas for designing the platform. The interpretation of the interview is included in the study as an analysis, where references are made to the online interview resumes which can be accessed, along with the interview guide in the online appendix: Online Appendix. The informants are presented in the following.

9.4.1 NIELS BETHLOWSKY KRISTENSEN

PROJECT MANAGER IN THE CLIMATE SECRETARIAT, MUNICIPALITY OF COPENHAGEN

Kristensen manages the aspect of the climate plan concerning energy projects and initiatives and how these should develop in the future. Kristensen's main focus is the green energy transition and how the future strategies should unfold. He deals with direct implementation, demonstration and research (Kristensen, 2018). Kristensen provides updated information on conditions in Copenhagen and what visions and initiatives the municipality is pursuing and what characterizes their network and resources. He provides an insight into the barriers the municipalities face, as well as what in his opinion should consist a viable platform to accommodate these. At this stage in the study the platform design is at its initial stage, which means that there is little foundation on which to discuss the design of the platform, and more so a focus on the general potential.

9.4.2 CRISTOFFER GREISEN

PROJECT MANAGER AT ENERGYLAB NORDHAVN, DTU

Greisen is the project manager at Energylab Norhavn (see ***Textbox 9***), which he has been for the three years that Energylab has run. The purpose of the EnergyLab project, is to develop integrated solutions to design the future economic efficient energy system. It is a large project with 12 partners including city and development stakeholders, energy companies, industry, consultants and 3 DTU institutes. Greisen coordinates internal processes and handles external communication and cooperation with stakeholders, creating contact with these and the project partners (Greisen, 2018). Greisen offers an innovative perspective on the platform concept as he has personal experience of what entails the process of innovation as well as creating viable conditions for innovation to thrive. Greisen also provides an insight into how many different stakeholders can be collected in networks of cooperation on local level

9.4.3 ANDERS HASSELAGER

SENIOR PROJECT MANAGER AT 'ENERGY ACROSS'

Hasselager is project manager at Energy Across (see ***Textbox 7***) which is a cooperation between 33 municipalities where 29 of them are located in the capital region. Energy Across has spanned over phase 1 in 2014-2015 and currently phase two is from 2016-2018 (Hasselager, 2018). Hasselager provides an insight into development of networks of cooperation and communication between many different stakeholders on regional and municipal level, including experience with citizen integration and strategic energy planning.

9.4.4 (1) KENNETH BERNARD KARLSSON AND (2) GIADA VENTURINI

(1) HEAD OF ENERGY SYSTEM ANALYSIS GROUP, DTU AND (2) PH.D.

Karlsson is head of Energy System Analysis, which is a modelling group at DTU (Technical University of Denmark). The group develops and uses energy system models – mainly optimization models. Venturini is a Ph.D. student in the same group as Karlsson and she has experience with stakeholder engagement and of including new stakeholders. The group analyses different energy proposals from Danish parties and other stakeholders and compares them by running them on the same model. The group is developing the TIMES-DK web-based interface (see ***Textbox 14***) for a broader audience, namely politicians and citizens and other stakeholders with non-technical backgrounds (Venturini & Karlsson, 2018). Karlsson and Venturini will provide an insight into what considerations should be made when designing a web interface platform which targets a more general audience, as well as their experiences with this.

9.5 SPATIAL ANALYSES

Spatial analyses and mapping is used to provide a foundation for developing a platform for stakeholder inclusion and cooperation. Most information which is used in policymaking contains a spatial element (Sieber, 2008), and policy-related information can be analysed and visualized spatially through maps and this can in an effective way, convey ideas and convince stakeholders of these (Sieber, 2008). Maps and related symbols, terms and colours has been a means for communicating information for a long time (Kraak & Ormeling, 2009). This means that maps have been standardized and that there is a mutual understanding of maps in society. They provide a helpful conception of space that is deemed applicable for a case where areal conflicts are to be expected. Thus, mapping fits well with the aims for the platform. The purpose of the spatial analyses is to investigate how spatial determinants can contribute in viable decision support for energy projects in Greater Copenhagen and to communicate this to a broad audience via maps. The analyses will be carried out by using cases to illustrate potential spatial applications in the platform.

Geographic Information Systems (GIS) is used to carry out the analyses. GIS is a tool used for spatial analyses and mapping where new information is created by altering or extracting existing data (Esri, 2004). GIS can integrate data from various sources both social, environmental, demographic and economic to support planning activities such as data processing, spatial analysis, visualisation etc. GIS has been applied in urban planning for e.g. selecting suitable locations, land use, transportation etc. GIS can also be integrated with urban planning models and multimedia data such as images and videos. Furthermore, there is increased availability of GIS data on the internet increasing the transparency of using the tool (Živković & Đorđević, 2016). It is the understanding of this study that GIS offers analytical opportunities in line with the purpose of the study. Through a range of tasks performed in sequence, datasets are clipped, selected and intersected in order to create useful information and visual representations (Esri, 2004). In short GIS is used to turn data into information, and subsequently into knowledge for the benefit of the study. Note that the cases applied in the study are used as examples on how a platform could be designed in a viable way, and results from the analyses are of less focus. For a detailed walkthrough of the GIS approach see Appendix A.

9.6 DESIGN THINKING AND RESEARCH DESIGN

Design Thinking is applied to structure the research. In this section Design Thinking will be explained, followed by the research design, concluding the chapter on theoretical framework and research design.

9.6.1 DESIGN THINKING

Design thinking revolves around innovation through stakeholder engagement. It is an approach to provide an innovative solution to a problem, by exploring creative ways in which to proceed in new directions and in doing this taking a “people first” approach to ensure that solutions become desirable for stakeholders (Brown, 2008). An important driver of the Design Thinking process is prototyping, where prototypes are used to get useful feedback and evolve an idea, to learn about its’ strengths and weaknesses and to identify new directions in which the product can be developed. As said by Brown (2008):

"…it was the result of hard work augmented by a creative human-centered discovery and followed by iterative cycles of prototyping, testing and refinement." (Brown, 2008 p. 88) on how design thinking happens.

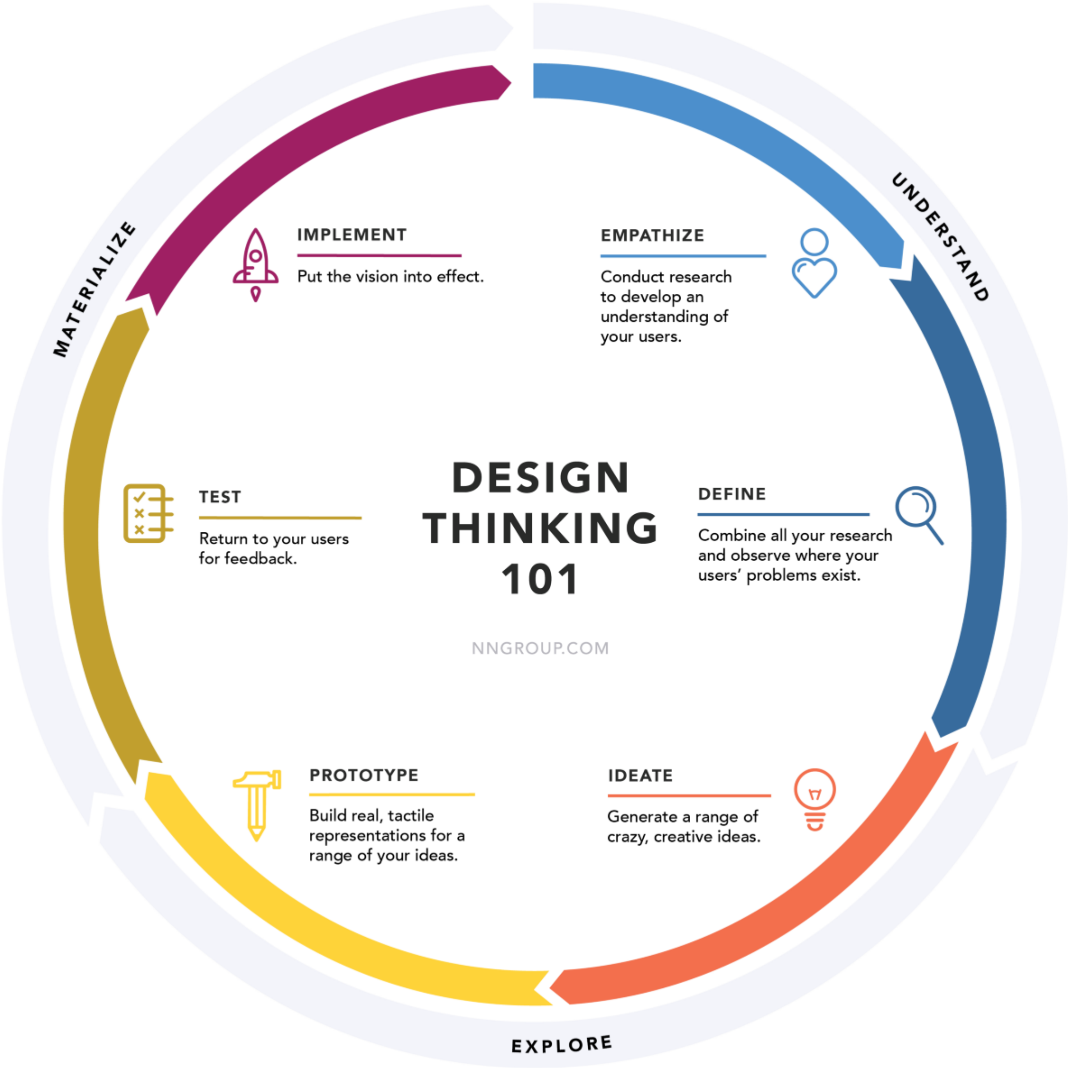


Figure 1: Design thinking from Andrew Nielsen (2017).

The study follows the process of Design Thinking as visualized in ***Figure 1*** from Andrew Nielsen (2017), where a iterative process is used in the research design. The process is made up of understanding the audience and their needs, exploring solutions through idea generation and materialization where the product is developed and tested. The results from the materialization process is then used to understand the needs more profoundly, which is used to refine the ideas and so on.

The problem analysis is the first step of understanding the stakeholders and their needs and as a result an idea of a web-based platform has been defined and the aim is to define a concept relevant for urban energy governance in Greater Copenhagen primo 2018, which is tested on some relevant stakeholders found in the problem analysis. The study does not create an actual prototype, which is considered beyond the scope of the study. Rather, the aim is to design a conceptual framework for a platform which is tested through stakeholder engagement. The study is carried out through an iterative process of stakeholder engagement and design of concept framework in a people-centered approach, where the platform concept is adapted continuously.

9.6.2 RESEARCH DESIGN

The research design follows the process of Design Thinking. It is an iterative process of understanding the barriers, exploring solutions and materializing the platform concept, in a stakeholder centred approach. In the following ***Figure 2*** the research design is visualised:

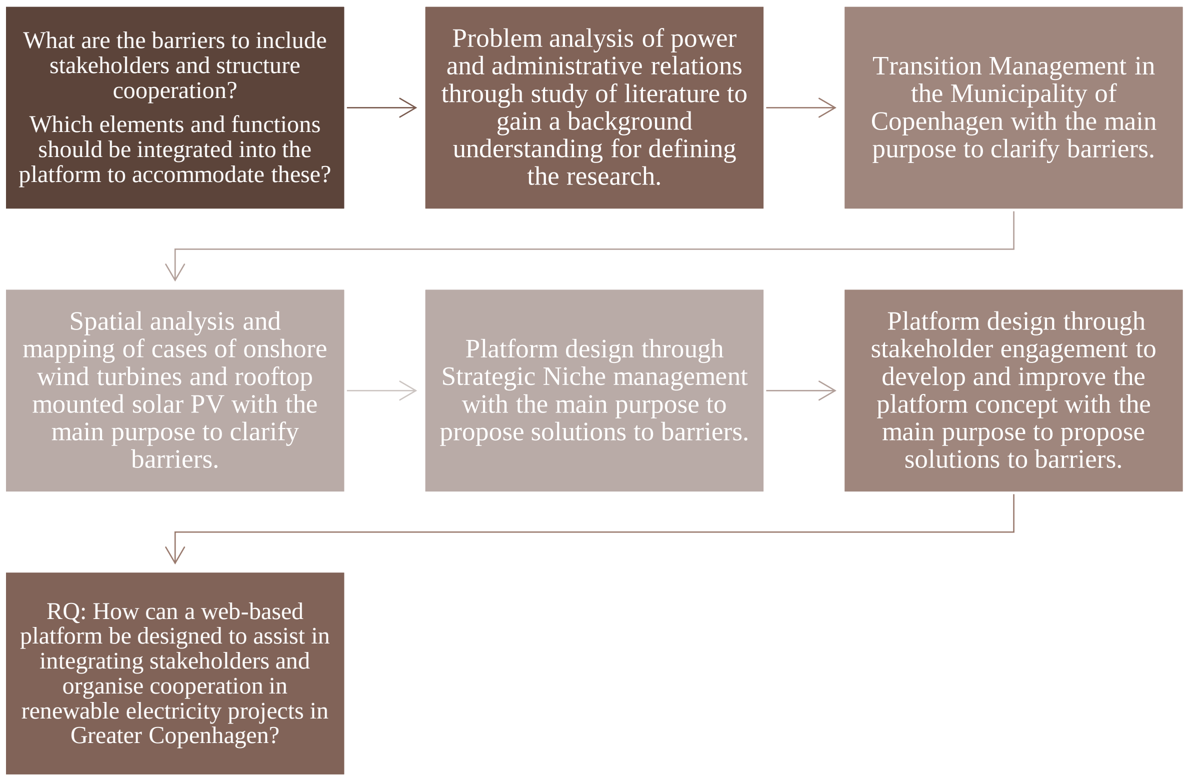


Figure 2: The Research Design

10 ANALYSES

In the analyses chapter, the theories and methods are applied. The first two analyses: Transition Management in the Municipality of Copenhagen and Spatial Analysis and Mapping are carried out with the main purpose of investigating barriers for the energy transition in Copenhagen in the context of the opportunities a spatial platform can offer. Thus, the barriers in these analyses represent a need which a platform will aim to fulfil. This provides a foundation for designing an initial platform concept in the analysis; Platform Design Through SNM and subsequently improving and developing the concept in the analysis; Platform Design Through Stakeholder Engagement. The analyses chapter is concluded with a range of theoretical and practical platform functions concretised through cases.

10.1 TRANSITION MANAGEMENT IN THE MUNICIPALITY OF COPENHAGEN

As mentioned in the method section Kristensen is project manager in the Climate Secretariat, at the Municipality of Copenhagen, and is included because of the importance of the municipality for energy governance in Greater Copenhagen. To carry out the analysis TM is adopted as the optimal way of managing the energy transition. The analysis is an interpretation of the interview which comprises a range of factual insights on how energy governance is carried out in the municipality as well as some more subjective opinions from the informant; Kristensen (2018). The insights are investigated according to the levels of governance in TM, and a subsequent interpretation of the barriers to optimal transition management is carried out. The barriers found in this analysis thus represent a need, which will assist in shaping the platform concept, which will later be adapted following the process of Design Thinking.

10.1.1 STRATEGIC

The municipality of Copenhagen has a goal of becoming the world's first CO_2 neutral capital by 2025 in the electricity sector. Energy planning in the Municipality spans over three implementation periods, and for each period a roadmap is designed. A work program for the period; 2012-2016, 2017-2020 and 2021-2025 respectively has been developed to reach the overall goal. Structuring the vision according such roadmaps is the municipalities' way of organising the process of transitioning to renewable energy. It is an attempt to make up for uncertainties of the future, and to ensure a concreteness that helps realise long term goals (Kristensen, 2018). One aim of the municipality is to have 460 MW wind turbines in 2025. As of 2018 there is approximately 113 MW capacity installed by the municipality. The goal is to implement both onshore and offshore turbines in the future. Another main goal defined by the municipality is to implement rooftop mounted solar PV to a large extent (Kristensen, 2018). In general energy production mainly needs to be located at sites already set aside for such purpose, where the site will be appointed to contain a more stressful construction. It is however expected that in the future, energy is likely to be more integrated part of urban space (Kristensen, 2018).

These goals presented by Kristensen (2018) are categorised on the strategic level as they set the overall context in which the energy transition is managed within the municipality. Doing so provides an understanding of how energy governance is practised by a central stakeholder in Greater Copenhagen. The goals defined on the tactical level will be submerged into other levels of governance and, depending on the learning effect this induces, the general strategy can be adapted or changed. For example, the goal of being CO_2 neutral by 2025 can be considered highly ambitious and might show suboptimal on the remaining levels of governance, and then the overall goal could be adjusted accordingly. Setting a goal makes for coordinating the remaining levels of governance and for defining barriers and how they are reflected on other levels.

10.1.2 TACTICAL

The goal of being CO_2 neutral by 2025 cannot be accomplished within the municipal boundaries alone and therefore cooperation is essential. An energy project is largely a product of cooperation and the municipality relies mostly on relations with other entities and stakeholders: Universities, knowledge institutions, private stakeholders, and utility companies. Which stakeholders the municipality cooperates with depends on the stage of the process and at what level the process is occurring. When it comes to municipal cooperation, 'Energy Across' is a valuable stakeholder in promoting cooperation and correlate initiatives and frames for energy matters to ensure that the goals are the same across municipal boundaries (Kristensen, 2018).

The municipality has direct power when it comes to the municipal buildings, their own fleet of vehicles and the public buildings. They also have a high influence through the utility companies, especially the municipally owned (and co-owned) companies. Moreover, energy projects are often funded by low interest loans through municipal credit. So, the municipality is involved to some extent in most projects and have high influence that has branched beyond the municipal organisation. Aspects where the municipality has little influence are on how companies utilise energy, what end-users do at home and the transport sector (besides busses and car sharing), where the power to control such aspects are more attributed the national level, through taxes, grants etc. Consequently, when the municipality wants to pursue initiatives of such nature, there is a need to enter into dialogue and so-called development partnerships with for example citizens and companies. These partnerships usually also involve universities. As a part of moving on to more challenging aspects of the energy transition, partnerships are now formed on less secure ground than previously. Instead of knowing the solution to an issue in advance, these partnerships will deal with issues where there are no obvious solutions to start with and therefore innovation will play an important part in these processes (Kristensen, 2018).

Kristensen (2018) states that the energy transition has reached a point where the large choices have been decided upon. Initiatives until now have been centered around the municipality, with the municipality as the central stakeholder. Now the time has come to address the more challenging aspects of the energy transition; the high hanging fruit, where citizens and companies need to be included in more “creative” ways. For example, to address the goal of having rooftop mounted solar PV, a large share of these needs to be put up by private stakeholders, where there is a need for dialogue and forming partnerships. A barrier related to this is that the current roadmap is not particularly citizen-centered, and it can be a significant challenge that citizens are not more included in the transition. The municipality could further the transition by engaging the citizens and should be better at communicating their goals and vision to citizens and informing them on how they can be integrated. There is a growing trend in the population of increasing interest in; optimizing use of resources, consuming less energy, and becoming environmentally friendly, where time is considered more mature for public inclusion, which presents a large potential which should be tapped into (Kristensen, 2018).

From this it is concluded that, there is an established network where the municipality can mobilise resources by cooperating with other stakeholders. The municipality has the opportunity of entering into development partnerships in cases where they have limited power. This all amounts to a defined set of structures which can be categorised as tactical governance, where structures in subsystems are practised to reach the goals on the strategic level. Defining structures on tactical level of governance enables pinpointing of some suboptimal structures and processes in relation to the relevant stakeholders on local level. A barrier which can be pointed out is a need to adapt the overall strategy to include citizens to a larger extent.

10.1.3 OPERATIONAL

Energy initiatives come in three forms: (1) Analysis, (2) test and demonstration and (3) implementation. There is a need to continuously re-evaluate initiatives to not create a sub-optimal lock in. Projects are tested on the short term for long term purposes and care should be taken to allow some technologies to develop before implementing them into the system because they might not be optimal on the long term (Kristensen, 2018). Projects where the municipality has been involved include; onshore and offshore wind turbines, burning of biomass at for example the Amager Powerplant and the (under construction) BIO4 plant which are the current main activities to reduce the CO_2. To reach the goal of 460 MW wind capacity, wind turbines have been installed onshore and offshore, and outside Greater Copenhagen as well, mainly in

Lolland and Jutland. Moreover, studies have been initiated to clarify the potential for offshore turbines in Øresund, and attempts are made to carry out onshore wind energy projects in Greater Copenhagen. In addition to this, innovation projects are also prioritized, where for example the municipality is a partner at EnergyLab Nordhavn, where solutions here are seen as a necessity for the future energy system (Kristensen, 2018).

Several attempts of putting up turbines in Copenhagen have failed due to areal conflicts, high land prices, visual and noise issues and neighbours (municipalities or landowners) which have stopped the process. There were plans of putting up turbines in Nordhavn and Kalvebod Brygge, however the processes were terminated although conditions were deemed viable for turbines at the locations. Projects related to rooftop mounted solar PV are also experiencing barriers, where the process is deemed long and complicated, and Kristensen lacks the overview over the implications, but for such projects there is a need for extensive dialogue and forming of partnerships where barriers are related to the law and bureaucracy (Kristensen, 2018).

These processes are categorised as operational as they represent local initiatives carried out over a relatively short timeframe. This is the level of governance where the transition is manifested in operational practises. Despite ambitious climate goals and established tactical governance structures, initiatives are being terminated along the process. There is a barrier which is particularly evident on operational level. It is unclear why exactly wind energy projects are terminated, and it might vary from project to project. However, it can be argued, that the premature termination of projects represents a lack of engagement from certain stakeholders or a lack of alignment of interests. This might derive from barriers on other levels of governance and would be a relevant tendency to investigate further.

10.1.4 REFLECTIVE

Kristensen (2018) explains that energy governance in general is considered a complicated and encompassing practise and is largely a learning-by-doing process, where networks and experience pave the path for the energy transition. Its’ complexity arises from encompassing multiple aspects of the system: Electricity, heat, gas, water, waste water, wind turbines, district cooling, district heating – an immense system, with multiple supplies and energy forms, where some can coexist, and others can’t. For stakeholders not educated in the field, e.g. politicians and citizens, energy can be an incomprehensible term. It is moreover a field, which is widely disagreed upon, also amongst expert stakeholders such as universities. Thus, it becomes a highly confusing environment for e.g. politicians, who are expected to have an insight in many aspects of society, when they need to argue for their choices on energy matters (Kristensen, 2018).

Kristensen (2018) reflects upon the potential for a platform in relation to the barriers experienced in the municipality. It is argued that using a platform in the energy transition would be interesting. There are many different ways of reaching the climate goals and perhaps a platform could help organise the process and induce viable choices. GIS is used for other purposes within the municipality, however the tool is not yet used much for energy purposes although, there are plenty of available compatible data e.g. data on energy consumption. It can be used for energy purposes to integrate a more spatial thinking in which to see possibilities for combined projects, which is helpful when designing solutions where space is limited. For example, GIS could be used to integrate citizens by defining rooftop areas for solar panels i.e. where roofs are south oriented, e.g. in classifications of building types or in combination with other initiatives such as noise insolation (Kristensen, 2018). Such information can be used to engage citizens, which are informed that they are potential stakeholders for rooftop mounted solar PV, so as to create a strong argument for engaging citizens and a foundation for dialogue and cooperation. The Municipality has defined a need to become better at visualising for the purpose of communication, and to make such information publicly available. Kristensen (2018) proposes that one example could be to develop a map over types of buildings, along with guidelines as to what is typically the best initiatives when you live in this type of building, this could be used to engage citizens effectively, providing them with a path for action (Kristensen, 2018). Another potential is to implement two-way communication where a platform is used by the municipality to announce that they are interested in e.g. starting a niche project with rooftop mounted solar PV where the energy produced is shared internally in an area or residential association. A platform could be used for communication between municipality, companies, universities and locals to form networks and cooperate the projects i.e. used as a matchmaking tool in the forming of cross-sectoral partnerships (Kristensen, 2018).

These observations are made based on experiences from the various levels of governance and are thus classified as reflective governance. The information is mainly related to the complexity of the energy systems which makes it hard to include certain stakeholders effectively and how this might be mitigated through a platform.

10.1.5 RESULTS

In ***Table 4*** key insights from the analysis are summarized in the context of the TM theory.

TRANSITION MANAGEMENT IN THE MUNICIPALITY OF COPENHAGEN	
Strategic	*The strategic level is considered highly ambitious as the municipality is determined for Copenhagen to be the world's first CO_2 neutral capital by 2025, where main goals are to implement onshore and offshore wind turbines and solar PV. Roadmaps have been developed for 2012-2016, 2017-2020 and 2021-2025.*
Tactical	*There is a need to engage citizens and companies in more "creative" ways, however the roadmaps are not citizen-centered, leading to suboptimal governance as stakeholders are excluded from the process. Cooperation is a central element in municipal strategy and there is a need to focus more on development partnerships with focus on private stakeholders in innovative processes. The challenge here is lack of strategies as to how to manage these processes and this results in a lack of direction.*
Operational	*Initiatives are distinguished: (1) Analysis, (2) test and demonstration and (3) implementation. Implementation initiatives focus on renewable energy sources, mainly wind and biomass whereas test and demonstration concerns integrated flexible energy systems. A barrier is related to experience of cases where even if conditions for wind turbines are feasible projects are terminated, resulting in wasted resources from involved stakeholders. Moreover, solar PV projects are considered highly complicated which is considered a significant barrier.*
Reflective	*It is deemed important to ensure a continuous learning-by-doing process through networks and experience. The complexity of the energy system is considered a barrier for integrating certain stakeholders, where experience has taught that energy is difficult to comprehend for non-experts, resulting in insecurity. Adding to this, the alternatives for the energy transition is widely disagreed upon, all in all resulting in a non-directed transition. A platform should therefore be used to engage a broad variety of stakeholders and further two-way communication and partnerships with private stakeholders.*

Table 4: Results of Transition Management in the Municipality of Copenhagen.

The first analysis has provided an initial foundation for designing a platform. Given the discovered barriers and the importance of the stakeholder for local energy governance, the municipality is considered a viable administrator of the platform. The municipality has the authority and interest in carrying out renewable energy projects, without being only profit driven. It has a large network with means to mobilise resources and further cooperation amongst stakeholders. Furthermore, it has a citizen centered focus which is deemed an important aspect of e-democracy. As a result, the platform is carried out as a tool for the municipality to overcome some central barriers and start picking the 'high hanging fruit' of the energy transition. This means that focus will be on development partnerships where stakeholders are gathered for projects where solutions are not necessarily known in advance and stakeholders are engaged and coordinated. During the interview, a main focus is on onshore wind turbines and rooftop mounted solar PV as projects considered viable for the energy transition from a local perspective. Based on this, two cases are chosen for further investigation.

10.2 SPATIAL ANALYSES AND MAPPING

These analyses will continue to examine existing barriers and explore the opportunities for developing a platform deemed viable for urban energy governance in Greater Copenhagen. This is done by carrying out spatial analyses and mapping supported by literature. Based on insights from; Kristensen (2018), two cases are examined: Wind turbines in Nordhavn and rooftop mounted solar PV in a built area in Copenhagen. The reason for applying cases is the convenience this provides in matter of directing the discussion during later stakeholder engagement, as well as investigating the potential for practical applications of the platform.

10.2.1 WIND TURBINES IN NORDHAVN

It is found in the interview; Kristensen (2018), that even though an area is deemed suitable for onshore wind turbines via the current framework, barriers to the process have presented themselves and, in some cases, shown fatal for the project. This is supported by Minter & Sørensen (2018) which finds that public resistance has resulted in termination of onshore wind energy projects with a planned capacity of about 305 MW in Denmark in 2017. For comparison the state goal is to implement 225 MW onshore wind energy capacity per year until 2020 (Minter & Sørensen, 2018). This indicates that the current framework for onshore turbines is suboptimal with the risk of wasted resources for involved stakeholders as well as slowing down the energy transition. One way to avoid public resistance is arguably to focus on implementing offshore capacity or carry out projects in areas with less area conflicts, which the municipality has done to some extent as found in the previous interview. However, this would be contradictory to transitions goals of increased stakeholder inclusion and increased transparency. It adds to the neglect of strategies for local benefits and cooperation in an inclusive energy transition. Moreover, according to Minter & Sørensen (2018), onshore wind energy production is still the cheapest form of renewable energy. It is therefore considered an important aspect of a cost-efficient energy transition. In the following the study will aim for a deeper understanding of barriers to the current process of carrying out wind energy projects with the aim of discovering potential needs which could be accommodated via a platform.

The Danish Business Agency has developed a mapping tool meant for municipalities in the process of finding suitable areas for wind turbines. Areas that are 400, 500 and 600 metres from nearest inhabited place are pointed out for wind turbines with a height of 100, 125 and 150 metres respectively, which is deemed the acceptable distance to avoid harming neighbours. Furthermore, various areal conflicts can be avoided by analysing whether there are conflicts for conservation, protection boundaries, mean windspeed etc. (*Vindmøller*, 2018). ***Figure 3*** illustrates a screenshot of the tool.

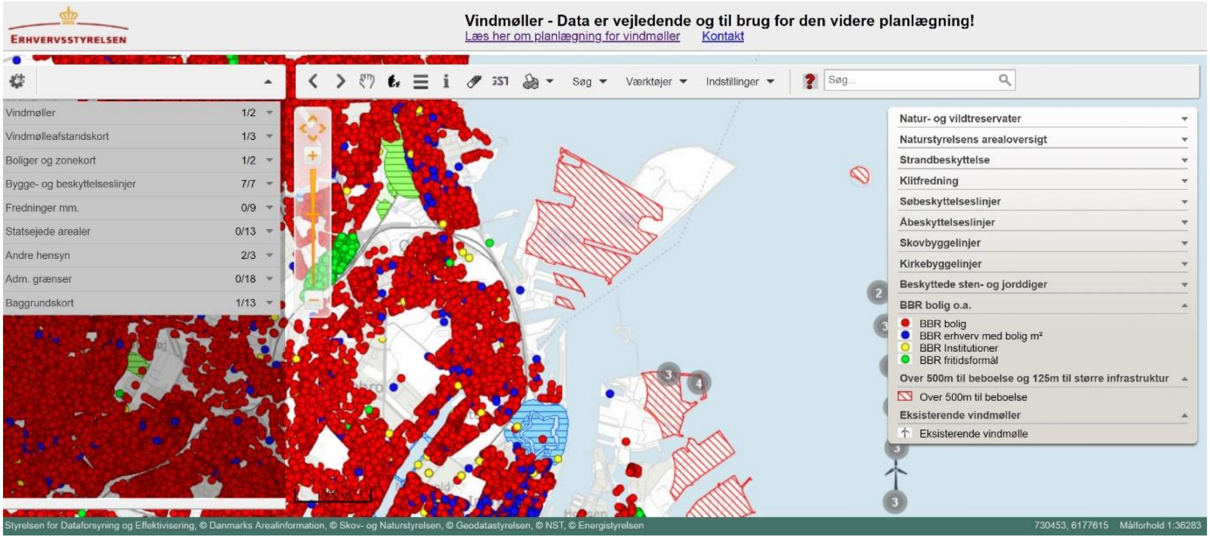
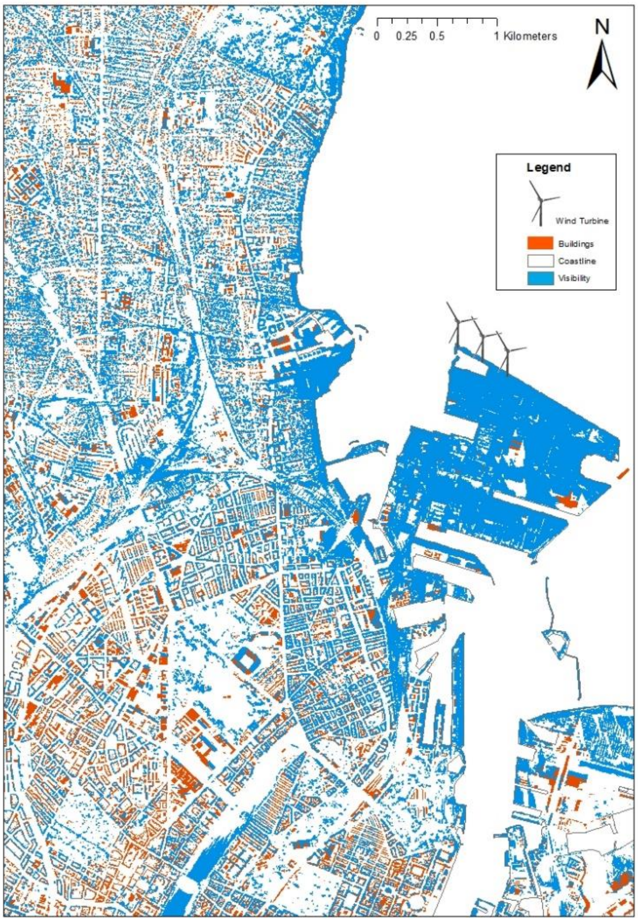


Figure 3: Tool developed for locating onshore wind turbines. Adapted from Vindmøller (2018).

Nordhavn is used as a case, as conditions should be feasible to place turbines here. From the tool, a spot for putting up turbines is selected on basis of the criteria for areal use i.e. layers are added to see if there are any conflicts. The location should be suitable for wind turbines up to 125 m. Currently the municipal plan for this area is that it will remain an industrial area, and in 2017 the Copenhagen citizen representation adopted the plan for this part of Nordhavn for harbour related activities, which are not considered sensitive to noise (*Ydre Nordhavn..*, 2017). A suitable wind turbine model could be the Vestas V80-2.0 VCS turbine, the same as located nearby at Prøvestenen, which are examples of larger onshore wind turbines in Copenhagen, suitable for the available wind resources in the area. They are 107 metres high with a diameter of 80 m. This information is from the Danish Energy Agency GIS database: *Download GIS-filer - Energistyrelsen* (2018).

One way to examine the consequences of the turbines further, is by focusing on the visual consequences. Especially within urban space, wind turbines this size are expected to have visual impact on a considerable area. Therefore, a visibility analysis is carried out. This is done by drawing the dimension of the wind turbines in GIS where three turbines are placed. According to *Vindmøller i Danmark* (2008) made by the Energy Agency, the visually optimal distance between wind turbines both in terms of aesthetics and turbulence is 3-4 times rotor diameter and thus the wind turbines are placed 240 metres apart. Afterwards a visibility analysis is made for the three turbines in relation to the elevation map and a combined visibility is illustrated in ***Map 1***, which shows where the three turbines will be visible. A more detailed walkthrough of the analysis is found in Appendix A: GIS Approach. The visibility analysis is a 3D analysis which determines the surface locations in a raster layer which are visible to the drawn points and indicates the visible consequences the wind turbine will have on the area (*Visibility*…, 2018). It is noted that the result indicates visibility from the top of the buildings and therefore the turbines are not necessarily visible from windows in the facade. However, it gives an indication as to the effect of the wind turbines. By examining the map, it can be seen that areas between buildings which are affected indicate that wind turbines are not only visible on the rooftops. If the ground in front of a building is affected this suggests that the turbines are visible from the facade as well.



Map 1: Visibility of three imagined wind turbines in Nordhavn. The blue field indicates where the wind turbines will be visible, and the orange field represents the buildings.

It is clear that new wind turbines will have visible implications on a significant part of Copenhagen. Considering what was found in the problem analysis, offering a 20 percent share of a wind turbine project to the residents within 4,5 km implies an inclusion of relatively few people in the process. For example, at Prøvestenen which hosts three turbines of the same dimension as this case, 20 percent corresponds to 2550 shares which are offered for residents within 4,5 km (*Praktiske* *oplysninger til andelshavere*…, 2018) which isn't considered many compared to the extent of people affected.

From the ***Textbox 15*** adapted from *Vindmøller i Danmark* (2008) it is evident that the process of implementing wind turbines is arguably well established. However, the question remains whether it is optimal to include stakeholders, citizens in particular in public meetings and subsequent treatment of the comments and oppositions, in a time consuming process, in a time when the internet provides an alternative? Can citizens, particularly those not opposed to the project, be expected to show up in person at several meetings. Comments and oppositions are treated after the meetings and hearings, and this arguably results in limited opportunity for dialogue According to Minter & Sørensen (2018), the traditional hearings that Danish municipalities host for citizens is deemed insufficient and old fashioned and instead municipalities should supplement with use of social media, where citizens at an early stage can ask questions and gain an influence over the project. There is a need to structure citizen participation so that they are included in the initial stages of the process, both the overall planning and regarding concrete projects. There should be early clarification of the consequences in a cooperative process between relevant stakeholders, and benefits should be felt locally (Minter & Sørensen, 2018). According to Minter & Sørensen (2018) there is a need to start taking citizen participation seriously, and not only limiting it to legitimizing decisions which are already made, but rather

Phases in Wind Turbine Planning

***1**. Appointment of Wind Turbine Locations*

Wind turbine areas are appointed where relevant authorities are included in hearings and typically a public meeting is held → Incoming comments and hearing response is treated → A municipal proposal is compiled consisting of selection and deselection of alternatives based on the environmental assessment as well as political interests amongst others → An environmental report is compiled which sums up the environmental assessment of the proposal → A publication phase is carried out where the proposal and the environmental report are made public. Typically, another public meeting is held → Treatment of incoming opposition and comments which can result in revision with a stakeholder consultation which can result in a potentially new publication phase → Adoption of the plan including definition of time limit for complaint.

***2**. Planning of the Actual Project*

Application for the project by builder in the appointed wind turbine area → Decision regarding EIA obligation → Idea phase and scoping where ideas and suggestions are collected by hearing for relevant authorities and typically a public meeting is held → Treatment of incoming comments and hearing response → Compilation of supplement to the municipal proposal and local plan including adaptation of the project based on an environmental assessment → Compilation of an EIA → Publication phase of the plan suggestions and the EIA of the project. Typically, a public meeting is held → Treatment of incoming oppositions and comments, which can result in revision with stakeholder consultation and a potential new publication phase → Final adoption of the plans as well as an EIA allowance. Definition of time limit for complaint.

Textbox 15: Phases in wind turbine planning adapted from Vindmøller i Danmark (2008).

including citizens to become active co-creators of the energy transition. There is a need to translate the knowledge to political action and concrete improvement of the process and this focus is important for the coming political negotiations (Minter & Sørensen, 2018).

The findings indicate that citizens are inadequately included in important stages of the process of carrying out onshore wind turbine projects, and that this makes a significant barrier to the process. It is therefore deemed necessary that citizens get a larger influence over; project design, ownership models and compensation for the consequences. Here a platform can be presented as an alternative or supplementary to the process of hearings and meetings and dialogue between stakeholders. To add depth to understanding how a platform might benefit the process of carrying out energy projects and accommodate some of the essential barriers in relation to this, the case of rooftop mounted solar PV is investigated in the following.

10.2.2 ROOFTOP MOUNTED SOLAR PV

It is found in the interview; Kristensen (2018), that a platform can be used to define potential stakeholders for private partnerships. For example, rooftop areas suitable for solar PV could be defined. According to Mathiesen et al. (2017) rooftop mounted solar PV is a viable solution for densely built areas, where areal conflicts need to be taken into consideration. PV costs are dropping, the technology has improved and has considerable potential for the future energy system, as it entails both energy savings, demand side initiatives, energy efficiency as well as being a renewable resource (Mathiesen et al., 2017). From a system perspective rooftop mounted solar PV would strengthen the competences within the integrated system design, where the theoretical potential for rooftop mounted solar PV in the capital region is 8,17 TWh/year (Mathiesen et al., 2017), and for comparison the combined Danish wind turbines produced 13,9 TWh in 2017 (Holst, 2017). All in all, the potential for rooftop mounted solar PV can be considered high in Greater Copenhagen. However, due to changes in regulation, over time it has become more complicated and less economically feasible to invest in solar PV facilities in Denmark (Mathiesen et al., 2017). This could be accommodated through changes in the overall framework, or as is the focus of this study; through local governance where stakeholders are engaged, and cooperation formed locally. Rooftop mounted solar PV will largely have to be integrated in the existing building stock. Furthermore, it was found in the interview; Kristensen (2018), that citizens play a central role when it comes to rooftop mounted solar PV. Thus, citizen engagement is investigated in the following.

The Energy Agency has made a guide for energy improvements which provides an overview over the relevant information for citizens who are considering making energy renovations where rooftop mounted solar PV is one possible initiative. The Agency lists good reasons for renovating such as; a lower energy bill, a healthy and comfortable indoor climate, increased sales value etc. depending on the need of the building (*Er Dit Hus Klar til Fremtiden?*, 2016). There are several options when it comes to getting grants for energy renovations[2]. Many energy companies provide support e.g. in the form of money or counselling how to energy improve, however the extent of support varies from one company to the other. Furthermore, there are periodical grants both national, local and municipal and energy companies will typically know of such initiatives (*Tilskud og fradrag*, 2018). Barriers to energy renovation measures include; too long pay-back times, free money is reserved for other purposes (new kitchen, larger windows etc.), a tendency to postpone renovations until absolutely necessary, lack of knowledge of the economy and comfort advantages of renovations and the issue of preserving architectures (*Er Dit Hus Klar til Fremtiden?*, 2016). Based on this the main barrier is not evidently related to lack of initiatives to include consumers for energy initiatives but more so to the complexity of such processes. Furthermore, Meyer et al., (2014) points to an issue regarding the lifespan of such investments. Houses can be expected to last for 50-100 years and thus new buildings alone cannot be expected to solve the problem of a high energy consumption, therefore it is important to catch the citizens at the right time before they make suboptimal investments, and the question is whether this is attempted today.

The information provided by the Energy Agency; *Er Dit Hus Klar til Fremtiden?* (2016) can be considered an example of how the internet is used without tapping into its' full potential for e-democracy. Information is delivered through text reports and occasional videoclips. The design has been made user friendly and information is presented graphically in an easily understandable way. However, there is little user interaction or forum for asking questions (besides emails) and the responsibility falls on the user to navigate the different webpages and stakeholders with multiple links to keep track off. This does arguably not fit well with dealing with such a complicated process as energy renovations where stakeholders are not necessarily experts. Moreover, There is a homepage called Sparenergi.dk as part of the Energy Agency which functions as a portfolio of energy renovation cases and is meant to inspire citizens (*Er Dit Hus Klar til Fremtiden?*, 2016). The guide is highly centred around the citizens where the

[2] *The energy savings agreement entails that net- and distribution -companies agree to work on furthering cost efficient energy savings for the benefit of consumers* (*Energiselskabernes energispareindsats…,* 2016).

responsibility lies with them to gather the information and take initiative, with a considerable amount of information and multiple homepages to navigate between.

The case summarised in ***Textbox 16***, adapted from *Varmepumpe, solceller og mindre varmetab*… (2018) is considered a typical case from Sparenergi.dk. It is arguably an example of unplanned factors contributing to the decision to renovate with the outcome of installing solar PV on the roof. Chances are that the technical and economic optimal solutions were not discovered through the energy check and the good payoff for the residents was due to their engagement and interest in the topic and such a level of engagement cannot be expected from all citizens. On the contrary, such an example is considered more likely to scare off citizens. However, as evident from the ECO-Life project, local projects with focus on stakeholder integration can result in implementation of solar PV.

The Process of Implementing Household Scale PV

One example of a case from Sparenergi.dk with energy initiatives (heat pump, PV, energy efficient windows and doors) was a family house from 1986 where some friends asked the residents to come along for an energy renovation meeting held by Høje Taastrup municipality which the residents did not know off in advance. The meeting was part of the ECO-life project, which included financial help for energy renovations and information on the topic. The residents were intrigued because their house needed other renovations, and they had been thinking of improving the energy performance for some time, however they didn't know where to start. Furthermore, these respective owners had an amateur interest in energy. The process was set in motion and there were several barriers along the way. The energy evaluation of the house was short and did not clarify which initiatives should be prioritized. Moreover, there were some miscalculations involved. However, the owners took it upon themselves to search the internet and engage in discussions with various suppliers, friends and family. The decision phase showed to be the longest, taking more time and effort than the building phase. However, they did get the economic support hey needed and they did most of the renovations themselves. They "thanked god" that they didn't know in advance how much work the renovation would take. However, they did choose to do a lot in one sitting. Solar PV was chosen as a solution and they are pleased with the results, having improved comfort with almost no bill for energy consumption and an increased estate value of 400,000 DKK which, the same amount as the loan they took.

Textbox 16: The process of implementing household scale PV. Adapted from Varmepumpe, solceller og mindre varmetab… (2018).

The process of implementing rooftop mounted solar PV is considered less defined compared to e.g. wind turbines as evident in ***Textbox 16*** and there is arguably a need for a strategy for engaging potential stakeholders effectively and target citizens and form viable partnerships, so that unnecessary resources are not spent in the process, and these initiatives become attractive. One approach is to engage actors based on a pre-definition of potential stakeholders by mapping the roofs deemed viable for solar PV i.e. the roofs with a suitable slope and orientation for optimal production under Danish conditions. The suitable roofs can be characterized as roofs with a slope of 15-55^{o} in relation to the water surface, and an orientation (so-called aspect) of +/- 40^{o} from south i.e. a 140-220^{o} interval. This is to keep the production within 10 percent from optimal under Danish conditions *(Tal og fakta - Dansk Solcelleforening*, 2018). Slope and aspect can be calculated in GIS based on the elevation map and then the optimal slope and aspect can be defined and cut according to the building stock found in the map of basic topographic data. The calculations are made for an area in Amager, Copenhagen of 1,7x1,5 km to illustrate the process. This results in a definition of the suitable roof areas that fulfil the requirements of slope and aspect, which are visualised in ***Map 2***. In this analysis the shadow effect is not taken into consideration. Neither are types of buildings, although small solar PV potential areas under 10 m^2 are sorted out to exclude the smallest areas. In addition, PV installations might be suboptimal as some roofs might not be strong enough to support PV installations, which may affect the appropriateness of the roofs, but the result is deemed legitimate in illustrating the potential for such an approach to defining potential stakeholders. A more detailed walkthrough of the analysis is found in Appendix A: GIS Approach.

Having defined the roofs viable to use for PV, various strategies can be pursued from here. For example, Mathiesen et al. (2017) argues that focus should be on large roofs of more than 450 m^2, where residents should be encouraged to go in on projects together. This is because large-scale PV generally has lower costs than small-scale (Mathiesen et al., 2017). There are 7 suitable roofs over 450 m^2 in the case area which could provide the circumstances for larger PV facilities. One example is 'Sundbyøster idrætsanlæg' owned by the municipality of Copenhagen, which is one of the largest roofs in the case area, where the area suitable for solar PV amounts to approximately 623 m^2. Other large roofs in the area, are apartment buildings where ownership can be expected to differ. Projects of this size would have different processes with different stakeholders and ownership compared to household scale projects.

Defining the roofs with potential for rooftop mounted solar PV provides an overview over potential stakeholders. Moreover, such a map can arguably be used to engage and inform citizens. Introducing a strategy for stakeholder engagement can help the municipality structure the process and overcome some obstacles related to the complexity of the process. This is considered helpful for Greater Copenhagen as the potential for solar PV is large and stakeholders are scattered over a large area. It can assist in engaging stakeholders and further cooperation early in the process as well as provide helpful means of communication.

Elevation map and map of basic topographic data

Aspect in the interval 140-220^o

Slope in the interval 15-55^o

Cut out to building stock

Map 2: The top picture to the left illustrates an orthophoto of the case area. The brown boxes illustrate the process of defining suitable roof areas for rooftop mounted solar PV mapped in the bottom map.

10.2.3 RESULTS

In ***Table 5*** some key insights from the spatial analyses and mapping are summarized.

Wind Turbines	***Rooftop Mounted Solar PV***
A negative attitude towards wind energy results in the termination of projects and is deemed suboptimal to the energy transition. Current means of citizen inclusion are considered inadequate and outdated, where few citizens are integrated in the process of implementing turbines and integration is limited to few stages of the process.	*The process of implementing solar PV is considered complex and difficult for non-expert stakeholders where currently the citizen engagement is limited to providing information via homepages, and there are indicators of lack of structure to the processes. An approach to stakeholder engagement is to define potential stakeholders i.e. buildings with suitable rooftop orientation for PV production.*

Table 5: Summary of the spatial analyses and mapping.

Through examination of the two cases, it is argued that the potential for digitalisation and the internet are not currently utilised optimally, and this is evident in current means of citizen integration and cooperation. Citizens are expected to do much of the leg work i.e. show up at meetings and hearings, navigate information and seek help from other stakeholders. This is arguably much to expect from stakeholders with little or no previous expertise in energy matters. The findings can be translated into an understanding that a platform could be particularly meaningful when it comes to citizen engagement and inclusion in energy projects. It is deemed sensible, when working to clarify the potential for e-democracy, that citizen participation is a central focus of the platform as it presents an opportunity to reach a broad variety of stakeholders in a more effective approach. It has already been established that citizens are likely stakeholders in development partnerships as found through the interview; Kristensen (2018) and thus citizen participation will be a dominant focus in the study.

The maps produced in the spatial analyses are thought to effectively communicate some of the circumstances of the two cases and can be used as a basis for discussing who to involve and how. Mapping can be considered an effective way to define and engage potential stakeholders and enable project formulations which suit local circumstances. Particularly when the potential stakeholders are scattered across Greater Copenhagen, which is the case with rooftop mounted solar PV. For the onshore turbines there is arguably a need to ensure a more effective public inclusion to mitigate the issue of public resistance later in the project period. It is estimated that a platform could become a valuable tool for addressing the barriers found in the study so far if designed appropriately, which will be of focus in the following analysis.

10.3 PLATFORM DESIGN THROUGH SNM

At this point it is estimated that there is sufficient information to carry out an initial platform design. The guidelines set up by SNM are applied to legitimize the platform and increase the likelihood for its' success. As mentioned in the method section, SNM is adopted as the optimal way of carrying out an innovation project, where conditions that are deemed feasible for an innovation to thrive are met. Application of SNM ensures a multilevel approach to designing the platform so that it fits within the sociotechnical context for which it is designed. It ensures that considerable focus is on developing a network, mobilising resources and having a well-defined vision for the innovation. The success of the platform is measured by its' capacity to mitigate barriers found in the study and whether it can be integrated into energy governance in Greater Copenhagen. In the following SNM is used to organise the knowledge gained so far into elements which should be integrated into the platform. It is distinguished between elements which are relevant to the platform itself and the projects carried out through it respectively. These elements will later be integrated as platform functions through stakeholder interviews.

10.3.1 EXPECTATIONS AND VISIONS

As mentioned in the method section, expectations and visions should be streamlined amongst stakeholders to direct development of the innovation and attract the attention of relevant stakeholders. It is thought to provide a direction to the learning process which has been found important for the transition, where solutions are not known in advance. Therefore, expectations and visions should be continuously specified and manifested in the design of the platform. The platform is designed for a defined audience, namely; planning authorities, policymakers, knowledge institutions and citizens. The platform is designed to be administrated by the municipalities which are expected to take it upon themselves to actively seek out potential stakeholders and organise these in a more strategic and inclusive approach to energy governance.

The expectations and visions for the platform are streamlined already in the development of the platform by including stakeholders in the understanding and exploration of solutions. This is accredited the Design Thinking approach undertaken by the study. By doing this, the platform is designed for relevant stakeholder's preferences and needs. Additionally, for the projects carried out via the platform expectations and visions should be included by enabling the involved stakeholders to communicate their needs and preferences throughout the process, and particularly enabling a clear understanding of these early in the process.

10.3.2 LEARNING

As mentioned in the method section, a broad learning effect is considered optimal, where learning happens on multiple dimensions and helps broaden cognitive frames. There is a distinction between learnings which assists in improving the platform concept and learning gained through projects carried out via the platform, both are considered valuable to the platform success. In both cases stakeholder inclusion is considered essential for learning. As mentioned in the above; Expectations and Visions, the platform should be designed based on preferences of the stakeholders, and continuously improved through a process of feedback and refinement, and here learning is an essential element. As the municipality has been defined as a potential administrator of the platform, it could cooperate with other stakeholders, and add elements to the platform continuously, so as to react upon learnings.

Key learnings for the platform are defined as; how to effectively include stakeholders and structure cooperation via a platform, preferences of the users and relevant stakeholders, as well as tapping into previous experiences with stakeholder engagement and cooperation, all in the process of developing a viable platform. The learning process becomes an essential part of the platform development, where solutions are not known from the beginning, but rather discovered along the way. Learning will thus be a continuous process, with inclusion of the perspectives of many different stakeholders. This will help broaden cognitive frames and induce learning of behaviour and preferences. This will assist in optimising the platform design in line with Design Thinking where stakeholders are in centrum of the process and the platform is adopted according to the learning effect.

When it comes to projects carried out via the platform, an essential aspect is the inclusion of stakeholders in the process. In previous analyses, citizens in particular have been found important for optimising the process, where inadequate citizen inclusion has been seen to result in termination and suboptimal processes. The platform can be used to redefine how citizens are included where citizens are not only considered consumers with defined needs and behaviour, but potentially important stakeholders, provided the establishment of a strategy for integration and cooperation. If more can be learned regarding citizens preferences when it comes to energy projects and potentially compensation or division of benefits, processes can be expected to be improved and barriers mitigated. Learning can be furthered through continuous digitalisation of information, stakeholder inclusion and effective communication.

10.3.3 NETWORKS

According to SNM networks are an important aspect of innovation. Networks are meant to facilitate and improve interactions between relevant stakeholders and mobilise necessary resources i.e. money, people and expertise for project success. The aim of the platform is to further an inclusive strategy in the energy transition, which implies integrating new stakeholders. As a result, development of networks is an important focus in the platform.

A need which has been found, is to provide a timelier means of communication to replace traditional hearings and reach a broader audience. The internet has been suggested as a way in which to reach many stakeholders, and by utilising the internet the platform is expected to provide a viable foundation onto which a network can develop to replace or compensate e.g. traditional hearings, meetings etc. A platform administrated by an authority arguably provides a legitimacy superior (energy wise) to existing social media sites such as Facebook, Twitter etc. and this would enable a network with a less skewed debate over energy projects.

When it comes to the platform itself, it can be argued that the optimal administrator of the platform should possess a large network with means of mobilising resources and stakeholders to improve the conditions for success of the platform i.e. participation of relevant stakeholders and mobilisation of resources. By ensuring that the platform is administrated by a stakeholder with a large network, smaller and new stakeholders can tap into resources by joining the platform and thus strengthening the incentive to do so. For this platform the municipality is proposed as the administrator.

The platform will strive to ensure a broad network across fields of knowledge to avoid suboptimal processes such as the ones seen regarding onshore wind turbines and rooftop mounted solar PV. By creating equal terms for stakeholders to discuss solutions the quality of the network can be improved. For this a space for general learning is proposed. This can be referred to as a digital showroom where users can get an overview over the process. Relevant stakeholders can contribute with their insights, visions and expectations, and information is targeted a broad audience. It can be used to share learning, include new stakeholders and ensure that projects are coordinated across stakeholders and levels.

10.3.4 PROTECTED SPACE

The platform is meant to be used for generating innovative; ideas, cooperation and networks which can be discussed and formed. Therefore, it is important to create a protected space in which the platform can take form and develop. This is done through ensuring involvement of necessary resources i.e. money, knowledge and power to safeguard the development.

The platform in itself is not considered an expensive measure, as its' main costs are related to website development and platform administration. The goal is for the platform to function as a tool, making energy project processes more efficient. When it comes to the development of the platform there is arguably a need to ensure that the platform is well developed and ready for market penetration before being taken into use. This means continuously following the Design Thinking approach, where prototyping is used to include stakeholders for feedback and the platform is adapted accordingly. It is moreover expected to take some time, before users become familiar with new practises, and there is a need to continuously nurture the development of the platform in the light of the insecurity which is to be expected with introducing the tool. This can arguably be done by spending extra resources on educating the users. Furthermore, branding, e.g. via social media, is considered a viable measure to focus on, especially in the beginning of the platform application period to create awareness of the tool.

When it comes to the projects carried out via the platform, these need sufficient funding which can be found with stakeholders with adequate resources. Even when a main goal is to include new stakeholders, there is still a need to protect the innovation. For this, stakeholders with deep networks or power are deemed helpful. In relation to this, politicians and organisations can be valuable stakeholders. For example, the municipality has proven ambitious regarding their climate goal and having a deep network, they are able to mobilise monetary resources for projects that help them reach this goal. Therefore, the municipality can be considered a central stakeholder. Citizens and business are also expected to assist in funding initiatives like rooftop mounted solar PV provided they are engaged and cooperation is structured. When it comes to knowledge resources, these are also important for the success of the platform to define projects and optimise the transition both technically, economically and socially. Therefore, there is need for broad variety of stakeholders.

10.3.5 NICHE-REGIME INTERACTION

Having a multilevel perspective is considered important to ensure that the platform fits with the sociotechnical system for which it is designed; energy governance in Greater Copenhagen. This can for example be done by involving a variety of stakeholders already integrated in the context e.g. authorities, politicians, knowledge institutions etc.

The platform is in itself considered fitting to the context of communication in a time where digitalisation and the internet are central tendencies, and the general society is considered receptive towards internet solutions. The platform aims for providing a timelier means of engagement compared to traditional hearings and meetings, where physical presence to a lesser extent is necessary, making participation more convenient for stakeholders in line with current dominant means of communications and engagement.

When it comes to the projects carried out via the platform, there is a need to ensure that these are fitting for the sociotechnical system. Central choices include prioritisation between projects according to prevailing consensus. This could e.g. be a prioritization between large PV facilities versus household scale facilities. Onshore versus offshore wind turbines etc. There are numerous choices to be made when defining an energy project, and as found in previous analysis there is disagreement over what the prioritizations should be. A platform is not expected to solve these disputes easily and solutions will depend on who the administrator of the platform is, at what scale the project is carried out and which stakeholders are included. In an increasingly complicated energy system the platform is expected to demonstrate its' strengths in directing the discussion, developing tactics and inducing a more efficient energy debate.

10.3.6 RESULTS

In ***Table 6*** key results of the application of SNM are summarized.

PLATFORM DESIGN THROUGH SNM	
Expectations and visions	*The importance of streamlining expectations and visions is recognised as essential to a successful innovation. To ensure this, it is proposed that relevant stakeholders are included in the design of the platform in a process of feedback and refinement as the one adopted in this study. During projects stakeholders are enabled to communicate their preferences early in the process to gain an influence and streamline expectations and visions.*
Learning	*The learning process is considered important as solutions are not necessarily known in advance. Learning is ensured through stakeholder inclusion, continuous digitalisation and effective communication. It is distinguished between: 1) Learning which helps improve the platform where platform features should be adapted and included by the platform administrator. 2) Learning which improves the projects, which regards; how to effectively include stakeholders and structure cooperation, user preferences, previous experiences with stakeholder engagement and cooperation.*

Networks	*Networks should facilitate and improve interactions between stakeholders and mobilize resources. They should be broad and inclusive. When it comes to the platform itself, it can be argued that the optimal administrator of the platform should possess a large network with means of mobilising resources and stakeholders. For the projects carried out via the platform it is deemed viable to provide a common ground on which to debate solutions, to further a constructive and effective debate and develop a viable network. For this a digital showroom is suggested which is a space for general learning, where relevant stakeholders contribute with knowledge, and information is targeted a broad audience.*
Protected space	*It is deemed important to ensure adequate resources: Money, knowledge and power by including municipalities, politicians and citizens as central stakeholders. Resources are spent on education and guidance regarding the use of the platform in the initial stage of its' application to ensure its' chance for success. The platform should be sufficiently developed for the sociotechnical system before it is taken into use. Moreover, users should be educated and guided, especially in the initial phase of its' application period. Regarding projects it is important to include stakeholders with adequate resources where the municipality e.g. is considered important for its network.*
Niche-regime interaction	*A multilevel-perspective ensures that the innovation will fit into the context for which it is designed. By including stakeholders already embedded in the socio-technical system this is ensured. The platform in itself is considered fitting to the context of communication in a time where digitalisation and the internet are central tendencies. Regarding energy projects carried out via the platform, solutions will depend on who the administrator of the platform is, at what scale the project is carried out and which stakeholders are included. The platform is expected to demonstrate its' strengths in; directing the discussion, developing tactics and inducing a more effective and open debate.*

Table 6: Results for Platform Design Through SNM.

The concept is illustrated in a poster, designed to get an overall and fast understanding of the platform. The purpose is to provide the informants of the following interviews with a relevant foundation on which to reflect upon. The poster is designed to be user friendly i.e. easily understandable, simple and to the point whilst leaving room for idea generation. The poster is illustrated in Appendix B: Poster.

10.4 PLATFORM DESIGN THROUGH STAKEHOLDER ENGAGEMENT

In this analysis four informants are engaged to learn about the strengths and weaknesses of the platform concept and identify new directions that it might take. As a result, the following is an expression of the individual opinions and experiences of; Greisen, Hasselager, Karlsson and Venturini respectively, which are applied in the study by comparing and analysing statements. As mentioned in the method section Greisen is project manager at EnergyLab, Nordhavn and is included because of his expertise in furthering energy innovation (Greisen, 2018). Hasselager is project manager at 'Energy Across', which as pointed out is a project on regional level with focus on strategic energy planning across Greater Copenhagen (Hasselager, 2018). Karlsson and Venturini are part of the energy system analysis group at DTU and are included because of their experience with developing a user-friendly web-based interface (Venturini & Karlsson, 2018).

In the following analysis, theoretical functions are defined by analysing the interviews, adding context to the elements proposed through SNM. The theoretical functions are deemed generally applicable to the platform in terms of mitigating the discovered barriers. Three functions are defined: Maps and Two-way Communication, Pre-defining Project Dimensions and Geographic Conditions and lastly; Integrating Proximity and Physical Presence. The theoretical functions provide a basis for defining practical functions applicable to the cases.

10.4.1 MAPS AND TWO-WAY COMMUNICATION

Through SNM, it is evident that networks are important for the platform success. It is also considered important who comprises the network to optimise the usefulness of it to the platform and the projects carried out. The following stakeholders, highlighted as particularly interesting by the informants, are analysed in the context of their contribution to the platform and what prerequisites should be met for them to be included effectively in a network. The derived platform function is; to integrate maps and two-way communication. The stakeholder categories include: Citizens, schools, politicians and knowledge institutions.

10.4.1.1 CITIZENS

Citizens are a central aspect of the context in which the platform is to be integrated. Energy projects in Greater Copenhagen are thought to involve citizens either through managing the consequences for neighbours or when it comes to citizen owned projects. Citizens are thus an important aspect of ensuring niche-regime interaction found viable through SNM. Venturini & Karlsson (2018) also acknowledges the importance of citizen inclusion. During workshops, the group has experienced a difference between what citizens discuss compared to other existing stakeholders. Citizen discussions are generally more open, resulting in radical choices, whereas established stakeholders put more constraints on their choices and have a predefined understanding of what is realistic. Typically, the existing stakeholders have an idea of what is important, and this is not necessarily true (Venturini & Karlsson, 2018). This indicates that it is not automatically a positive thing, to have a pre-defined understanding of the energy system, and new stakeholders can offer a new and potentially significant perspective upon the transition, especially when projects are considered innovative and concern citizen compensation and inclusion. When engaging citizens for a platform project, a strategy could be to open for innovative idea generation, where citizen gain influence over the project and it is made sure that citizens are heard via effective communication. By including citizens, the network becomes broad and diverse which poses some challenges when it comes to steering the debate. There might be a need to integrate a moderator or other types of steering measures in cases with many users and opinions to ensure relevancy and direction to the debate. Lastly, there will be an increasing need to adapt information to citizens which cannot be expected to have much knowledge of technical solutions or system optimisation in advance, and this would be another element to consider later in the study.

According to Greisen (2018) there is a general need to include more stakeholders that understand human behaviour, as citizens are not currently involved optimally. The example Greisen provides is that when DTU makes energy calculations, citizens are thought of in line with the dishwasher, heat exchanger and other inventory, and this leads to faulted results. Citizen behaviour needs to be better incorporated to ensure that it becomes increasingly appropriate in terms of energy, so that behaviour does not result in suboptimal energy performance of buildings or appliances. This is mitigated by generally involving stakeholders with better understanding of human behaviour and incorporating this into the process (Greisen, 2018). This could for example be relevant when carrying out projects with solar PV where there might be a need to alter consumer behaviour in relation to PV production, for the project to be rentable. Here human behaviour becomes an important aspect and there might be a need to make changes in consumption patterns. There might moreover be a need to adapt projects to human behaviour. For this, stakeholders with an understanding of human behaviour could offer helpful insights.

10.4.1.2 SCHOOLS

Schools are argued by Greisen (2018) as potential partners for collaboration on energy projects to teach energy science to the general public. CIS is an example of a large stakeholder which has been included as a demonstration host in EnergyLab. When it is allowed to produce, the school is the largest energy producer in Nordhavn and is considered a valuable partner with interest in branding itself to a broad audience for its' sustainable profile (Greisen, 2018). In relation to this, Venturini & Karlsson (2018) argues for integrating schools as a way of furthering a broader knowledge, and schools might become valuable partners for future energy and/or sustainability projects (Venturini & Karlsson, 2018). When it comes to defining projects for a platform, they can be defined through mapping in line with what was done in the spatial analysis, where the schools could be approached based on the suitability of the roof and the possibility for branding themselves on sustainability. Schools can be expected to have consumption patterns suitable for solar PV production, as the main consumption is attributed during day hours. Moreover, schools generally have large roof areas suitable for larger facilities. Lastly schools can be considered important for the general attitude and knowledge of energy, as it becomes possible to integrate knowledge into teachings.

10.4.1.3 POLITICIANS

Politicians are also defined as important stakeholders. Hasselager (2018) explains that many politicians build their profiles on sustainable energy, and the debate is fierce, described as a 'battleground' until the election expected in June 2019, where green energy will be a dominant focus (Hasselager, 2018). Politicians can be considered important for their overall perspective where they can consider the energy processes in relation to society. Moreover, they can create awareness amongst voters. The nature of their inclusion in the platform would depend on the projects and whether the political stakeholder is; a member of the parliament, a member of a city council, a minister etc. For example, members of a city council concern themselves with municipal processes and initiatives and will play a different role on the platform than e.g. ministers who are responsible for sectors on a national perspective. As the platform in this study is limited to Greater Copenhagen, stakeholders are mainly expected to be local politicians and authorities. In relation to this, Greisen (2018) stresses that the Municipality of Copenhagen is highly receptive towards innovative ideas. They have created a large challenge for themselves by setting a goal of being CO_2 neutral by 2025 and have difficulties reaching this goal. As it helps them realise their climate goal, the Municipality is still interested in investing in solar PV facilities, even though the legislative framework is making it economically unattractive. The municipality has considerable means to contact and organise stakeholders to further projects and can be an essential stakeholder in a platform (Greisen, 2018)[3]. The municipality is deemed valuable as an administrator of the platform with means to secure a protected space through its' large network and authority.

10.4.1.4 KNOWLEGDE INSTITUTIONS

Another important group of stakeholders are knowledge institutions. According to Hasselager (2018) there is a vast amount of existing research, including large programs such as: EU projects, The Energy Agency's EUDP, regional projects, university projects etc. It is argued by Hasselager (2018) that such knowledge should be organised and made available beyond the current structure, where the research is available at the individual webpage of the stakeholders

[3] *It is noted that the municipality is not considered an entirely political stakeholder, however there are political stakeholders associated with the municipality.*

(Hasselager, 2018). In EnergyLab, knowledge is mobilised by including a certain basket of knowledge stakeholders, namely; students, smaller companies and development departments which have shown particularly valuable for innovation as these stakeholders are less restricted when it comes to idea generation (Greisen, 2018). This can be considered one way of mobilising knowledge and gathering it on common ground which could also be applied in the platform. For example, university students could be motivated to participate in platform projects in connection with school projects and they would be able to draw on expertise of professors and university resources. Another aspect Greisen (2018) points out which makes these types of smaller, more independent stakeholders important, is to accommodate the prevailing mindset towards energy projects, which is a fear of making mistakes. Mistakes are a necessary part of developing innovative solutions in a learning by doing process. This is something that the smaller stakeholders are generally better at than larger ones, and as a result, small projects are often seen to make significant differences. Large companies adapt to the conditions for innovation by posting employees in innovative environments e.g. in development departments to “release them from the chains from home” (Greisen, 2018). This indicates that new and independent stakeholders are important in terms of idea generation, as these are more free to pursue innovative ideas that might fail, where learning by doing is an aspect of the process.

Another issue related to knowledge institutions pointed out by Venturini & Karlsson (2018) is the omission of certain stakeholders from the debate. The government has all the resources for making highly sophisticated analyses, whereas the political opposition parties, NGOs etc. do not have free access to agencies to develop their own scenarios and this leads to a suboptimal debate where stakeholders enter into the discussion on unequal terms (Venturini & Karlsson, 2018). The fact that some stakeholders lack the resources for entering into the debate is considered a barrier which should not be manifested on the platform, and users of the platform should engage in the debate on more equal terms.

10.4.1.5 SOLUTIONS

The informants suggest integrating a broad variety of stakeholders with different backgrounds motivated by different values. These are the stakeholders found important, but other stakeholders are also considered relevant to include depending on the project. From an SNM point of view developing a network is considered meaningful for the platform in terms of learning where focus is on behaviour and relations. For example, stakeholders with understanding of human behaviour could help further learning which is helpful for the projects carried out on the platform, and the learning generated by engaging citizens can help develop strategies for a more inclusive energy transition. Moreover, networks are important to mobilise resources, where politicians and schools are deemed valuable for their will to brand themselves on green energy and the municipality for its' willingness and resources in terms of network and authority. Resources can also be mobilised through citizen funded projects e.g. rooftop mounted solar PV. By mobilising viable resources e.g. money and knowledge, a protected space can be created in line with SNM. Lastly, including relevant stakeholders is thought to ensure that the design of the platform is fitting to the sociotechnical system for which it is designed, which is in line with niche-regime interaction found viable through SNM.

There is arguably a need to continuously nurture the network to access resources and adapt stakeholder engagement to the relevant conditions e.g. time, place and learnings. As the platform is designed for carrying out different projects, the platform design should be adapted to a dynamic network which contains a broad variety of stakeholders. For this, the internet offers possibilities for communication which is continuous and effective. Adding a function which enables the user to enter into a dialogue with other stakeholders, including the administrator of the platform, is considered beneficial for 1) understanding stakeholders better, 2) enabling users to gain influence over a project and 3) access new knowledge. It is considered superior to traditional hearings in the respect that it provides possibilities for dialogue more so in line with timely means of communication in society. More people can be expected to participate as they would need to use less personal resources to do so, and communication could be practised more swiftly. On the downside it becomes less personal and some people might not be positive to such means of communication.

Integrating the suggested stakeholders entails a need to design a platform which can reach many and various stakeholders which means that information and design should be retrofitted this. According to Venturini & Karlsson (2018) when designing an interactive web-page for a broad scope of stakeholders, care should be taken not to make it too complicated. It can be made user friendly by minimizing the dimensions that the user can alter. Every option that the user can chose, should be supported by information on what the user is working on and when possible, the interface should be designed to be self-explanatory. It is important that users through the interface get an understanding of which aspects are important and to create a foundation for debating different alternatives. Moreover, Venturini & Karlsson (2018) argues that topics should be made interesting to a broad audience and to accommodate this, knowledge cannot only be presented by numbers and graphs. It needs to be made more picturesque, where maps or figures are used to explain and use relatable quantities (Venturini & Karlsson, 2018). In relation to this, Hasselager (2018) explains that today energy information is mostly presented to consumers in the form of graphs, but mapping could be a better way to visualise information.

Particularly considering the aim to include citizens, there is arguably an increased need to ensure direction to communication. Therefore, a communication function arguably needs to be supported by a function which helps direct the discussion to ensure its' relevancy to the projects carried out via the platform. For this, interactive maps are suggested in order to create a mutual understanding of the relevant topics to discuss. Mapping is considered a useful means of communication where maps, graphs and figures can be combined to provide information to the user in an easily understandable and interactive way. It can be considered user friendly when the user interacts with the map. Not all information is provided at once, and it becomes a more dynamic learning process with a strong place-based understanding, where users recognise landmarks and neighbourhoods on the map. Interactive maps are suggested as a means to make it as easy as possible for the user to be integrated into a project and to create a good foundation for debating alternatives e.g. compare different locations of energy projects on the same ground and map the results for users to evaluate. These elements combined are proposed to comprise the digital showroom found viable through SNM to develop a network. The maps and two-way communications function is summarized in ***Table 7*** along with the barriers and needs it is derived from, the proposed solutions by the informants and the related elements from SNM.

Barrier/Need	***Solution***	***Derived Function***	***Elements from SNM***
Stakeholders enter into the debate on unequal terms and there is a need for a more inclusive strategy to energy governance, and this entails many stakeholders with different backgrounds and interests and a need to go about inclusion in new ways.	*Stakeholders should be mobilized in networks where a common foundation for debate is created. The tool should be made simple by minimizing dimensions for the user to alter, information should be made picturesque.*	***Interactive maps and figures and two-way communication possibilities.***	*Networks* *Learning* *Protected Space* *Niche-regime interaction*

Table 7: The two-way communications function.

10.4.2 PRE-DEFINING PROJECT DIMENSIONS AND GEOGRAPHIC CONDITIONS

This function is derived from information related to the ongoing debate over alternatives in the energy transition. Barriers discovered include; a flawed time perspective, interchangeable frameworks and a skewed and non-transparent energy debate, where expectations and visions are not aligned amongst stakeholders. With a risk of these barrier emerging on the platform as well, the derived function of pre-defining project dimensions and geographic conditions is defined in this section. It relates to how to direct discussion onto meaningful paths and ensure that processes carried out via the platform are solution-oriented.

10.4.2.1 THE TIME PERSPECTIVE AND INTERCHANGEABLE FRAMEWORKS

The time perspective has been included previously and is considered an important aspect of introducing a strategic approach to governance. TM is used to understand how governance can be seen as processes over different time frames. Moreover, in SNM it is stressed that niche-regime interaction is essential, and for this the innovation needs to be adapted to the relevant sociotechnical system. Besides ensuring that the innovation is adapted to the current system, there is a need to coordinate short term initiatives and long-term goals. Venturini & Karlsson (2018) argues that there is too much focus on short term initiatives and a lack of long-term policies today. According to Hasselager (2018) the problem with the time perspective, is that it is hard to plan future energy projects when the framework conditions for renewable energy changes all the time, and there is a need to go about it in a stepwise approach where a range of initiatives are defined for different time intervals (Hasselager, 2018). The interchangeability of the overall framework has been argued in previous analyses where e.g. the framework for solar PV has been seen to change drastically. Hasselager (2018) argues that the conflicts of what alternatives and policies should be favoured, causes uncertainty amongst involved stakeholders, particularly in the light of the heated debate prior to the election. Utility companies do not know which framework conditions to expect in the future and are insecure about what investments to make. The same goes for municipalities as their role in the process is unclear (Hasselager, 2018). As the platform is considered a local initiative, it is not expected to offer a solution to barriers found on national level i.e. the overall framework, and the focus is more so on how the platform can exist in such an environment and still contribute to local energy governance. In relation to this, Greisen (2018) argues, that rather than being dependent upon changes in the overall framework, or spending valuably resources on criticising current conditions, EnergyLab strives towards developing innovative ways in which energy projects can be pursued in spite of legislative barriers. Greisen has the perspective that an energy system is complex; it will never be finished but continuously improved. By viewed it as a continuous process and not a problem with one clear solution, it becomes clearer how projects can contribute. Focus should be on working with how the responsibility is distributed currently to see if a closer cooperation can be formed e.g. through data sharing. This is the most appropriate definition of an energy system according to Greisen (2018). This perspective is considered relevant to this study when considering initiatives on local levels of governance and in line with the platform aim to develop a constructive and solution-oriented tool which is applicable to current conditions.

10.4.2.2 DEBATE OVER ALTERNATIVES

The debate over alternatives has been investigated in previous analyses. From Kristensen, (2018) it was found, that energy alternatives are disagreed upon, also amongst experts. Moreover, in the spatial analysis, citizens are found to have insufficient forum for discussing wind turbine projects, adding a skewness to the debate and risking a negative attitude later in the project period. Disagreement amongst stakeholders has also shown to result in a suboptimal project like the CIS case and energy renovation cases as well.

Hasselager (2018) argues that stakeholders disagree over alternatives and policies, particularly in the light of the heated debate prior to the election. This is deemed a significant barrier as it is considered an unconstructive process, which should not be manifested onto the platform. It is considered important that stakeholders entering into a cooperation via the platform practise a solution-oriented debate. Therefore, the platform arguably needs to collect the stakeholders where there is potential to coordinate expectations and visions, which is an element found important in SNM. For example, Greisen (2018) explains that CIS has resources and interests in branding itself with a green image. Contrary to this, citizens usually need to associate more immediate values with energy projects such as money or convenience rather than sustainability, and there is a need to adapt the information and values to the different stakeholders (Greisen, 2018). Greisen (2018) argues that failure to organise stakeholders in the beginning of a project can lead to significant barriers later, both in terms of interest conflicts and project outcome. For example, in cases with buildings, where architects and energy experts need to work together in optimizing the design for e.g. solar PV, and for this, visions need to correlate across stakeholders at an early stage of a project (Greisen, 2018). Conclusively, it is considered suboptimal when stakeholders join a project with conflicting expectations and visions. Focusing on streamlining stakeholders early in the project is considered a potential way in which to mitigate the barrier of the unconstructive debate over alternatives as it assists with furthering a solution-oriented process.

10.4.2.3 NON-TRANSPARENT ENERGY SECTOR

Transparency has not been of much focus in this study. However, it is a relevant topic to include as the degree of transparency in processes can influence which stakeholders are included, the attitude towards the project by included and affected stakeholders, as well as the outcome of projects.

Venturini & Karlsson (2018) argues that the energy transition is private and non-transparent and there is a general need to direct the discussion towards a more meaningful and productive path, which is more transparent to stakeholders (Venturini & Karlsson, 2018). For example, Hasselager (2018) explains that there is much at stake for mayors which are important players in the energy transition and have the influence to choose between alternatives. Mayors risk being heavily criticised for choosing one alternative and thus become vulnerable as it can hurt their chances at the next election. This is the conditions under which first movers work and politicians are generally cautious of putting themselves in such positions (Hasselager, 2018). This adds to the insecurity already found in the energy debate over alternatives and is expected to make stakeholders hesitant to enter into innovative projects, particularly stakeholders for which the risk is high (Hasselager, 2018). It is deemed relevant to make an effort to mitigate the barrier of non-transparency and this might be done by opening up for the process to more stakeholders earlier in the project period, so as to induce an understanding of the choices being made for the project. However, this also poses a challenge. As an example, Venturini & Karlsson (2018) wants to include NGOs who are keen to enter the debate, but the hard part is getting them to formulate visions to model and be compared on the same ground as other visions. A reason for this is proposed by Venturini & Karlsson (2018) as the difficulties with making a complete vision. It is easier to criticise aspects of the ones being made by others. There is a clear barrier here related to transparency, and a need to create a consensus that it is alright to engage in discussion without having a full plan and instead open for discussion of solutions in a process of cooperation. This way, ideas are discussed on common ground and used to work towards a full plan in a more inclusive and productive process (Venturini & Karlsson, 2018). There is arguably a need to make processes on the platform transparent to convince more stakeholders to join and to mitigate uncertainties over alternatives. The fact that solutions might not be known in advance should be communicated to create a consensus that through idea generation and testing solutions will be found, making it essential that discussion is productive and solution-oriented.

10.4.2.4 SOLUTIONS

The informants indicate that governance is caught in attempting to govern the long-term energy transition with short term initiatives under an interchangeable framework through a non-transparent process and skewed debate. This is something which can be supported by previous findings in the study and can be considered central barriers to the platform and its' processes e.g. interchangeable conditions for solar PV and suboptimal strategies for public inclusion. The information organised in this section provides an understanding of the conditions which a platform needs to be integrated into. In relation to SNM this relates to niche-regime interaction where the platform needs to be designed for the prevailing sociotechnical conditions to optimise its' chances for success. Although the platform is not expected to solve the barriers found in this section, attempts should be made to ensure that they are not manifested on the platform. In an optimal scenario the platform would develop and become applicable to a larger geographic extent than Greater Copenhagen and assists in mitigating some of the national barriers appointed in this section, however this is considered beyond the scope of this study and the current development stage of the platform.

Greisen (2018) argues that there is a need for stakeholders to find each other somehow, to join stakeholders over a cause, and to organise them early in the process (Greisen, 2018). For stakeholders to gather for energy projects over the platform, there is arguably a need for streamlining expectations and visions and organising stakeholders in relation to what they expect to gain or accomplish by joining the platform. In relation to the projects carried out, this could relate to expectations for the projects themselves as well as the nature of stakeholder involvement. Stakeholders will have different expectations and visions depending on the type of stakeholder. A way to streamline the stakeholders is arguably to create a common foundation on which to establish a discussion and cooperation. This can arguably be done by defining what kind of project is wanted before engaging stakeholders i.e. pre-definitions of projects before the platform is taken into use. However, this does not accommodate the problem of non-transparency of the energy sector with the risk of leaving out stakeholders from governance. As a measure to create a fairer energy debate, where the process is opened up for relevant stakeholders Venturini & Karlsson (2018) argues for enabling stakeholders to present alternatives on a common ground. This enables focus on the aspects that are relevant and to guide discussion. It helps point out whether there really is a significant difference between alternatives or if the factors discussed are marginal. In short, it improves the quality of the debate (Venturini & Karlsson, 2018). In this study it is considered a viable option, to enable stakeholders to choose between alternatives and to compare them on equal ground. To accommodate the need for increased transparency, a variety can be added to pre-defining projects. Arguably definitions should be sufficiently general to allow users to gain influence on the projects e.g. in terms of ownership, compensation, choosing between various locations etc.

If the geographic conditions and project dimensions are pre-defined, these can act as a common ground on which to gather stakeholders and structure cooperation. By this it is not meant that stakeholders do not get an influence over the project as this is deemed suboptimal from previous analyses. However, having some sort of pre-definition of the geographic scope and project dimensions is deemed helpful to engage potential stakeholders and direct discussion and cooperation in a solution-oriented process. The resulting function is thus a weighing between; allowing stakeholders to propose alternatives and pre-defining projects. For example, a pre-definition could be that three onshore wind turbines needed to be built in Greater Copenhagen and there are five potential locations suitable in terms of distance from nearest neighbours and other areal uses and environmental considerations. On this common ground users could engage in a discussion of the alternatives and e.g. propose measures for compensation and division of benefits. The pre-defining project dimensions and geographic conditions function is summarized in ***Table 8*** along with the barriers and needs it is derived from, the proposed solutions by the informants and the related elements from SNM.

Barrier/Need	*Solution*	*Derived Function*	*Elements from SNM*
Local governance is subject to interchangeable frameworks. There is disagreement over prioritization of alternatives in a skewed energy debate which is non-transparent.	*Creating a common ground for discussion and directing discussion onto more solution-oriented paths. Entering into projects without having the solutions opening up for the process and thus increasing transparency.*	***Pre-defining project dimensions and geographic conditions, allowing users to evaluate alternatives and affect the project outcome.***	*Expectations and visions* *Niche-regime interaction*

Table 8: The pre-defining project dimensions and geographic conditions function.

10.4.3 INTEGRATING PROXIMITY AND PHYSICAL PRESENCE

This function is derived from information on how to create a safe space for an innovation to ensure that the platform can develop and mature, so that it can be integrated into the sociotechnical system for which it is designed, which is found viable through SNM. Defined barriers are related to the need for physical presence in the process of idea generation. Moreover, current measures for stakeholder organisation are deemed inadequately tailored to local circumstances. Information regards strategies for accommodating these barriers: How to ensure, that stakeholders are effectively included in terms of training to use a new tool, how projects can be organised, protection of new cooperation, and providing a space for idea generation and development. The derived function is; to integrate proximity and physical presence into the platform concept.

10.4.3.1 NEED FOR PROXIMITY

Proximity has been somewhat debated previously in the study, where it is considered important for including stakeholders affected by energy projects e.g. neighbours to wind turbines. Furthermore, the platform has been proposed as a tool for reaching more stakeholders on a larger geographic scale. However, the informants indicate that proximity is likely more important and nuanced than what has been indicated until now. Greisen (2018) offers several arguments in favour of proximity and physical presence when carrying out energy projects. For one, it is argued that even when designing an internet-based platform, geographic factors are still important, where stakeholders living in the same area are likely to form similar associations and opinions on matters. Furthermore, people learn and get inspired from those they meet. Proximity is also considered an important aspect of idea generation. Greisen (2018) argues that physical proximity allows for stakeholders to meet easily and it becomes more convenient to ensure a continuous learning process, where faults are corrected, and experience is built upon in a local community. Especially when it comes to citizens, proximity can be considered important. Citizens need to be well informed and mistakes (which are inevitable when carrying out an innovative project) continuously corrected by involved stakeholders. Often citizens need to see the solutions for themselves where they need to visit the places and get information – to see the convenience that can be associated with energy initiatives (Greisen, 2018). Lastly, barriers can occur for processes which are documented in detail, where stakeholders are restrained in speaking their mind and immediate ideas when statements are logged (Greisen, 2018). It is considered a significant barrier that stakeholders are restricted in discussion and idea generation when the process is documented, as it is deemed suboptimal to have this non-transparancy within energy processes as found in the previous section, where a solution was provided to change the consensus for entering into the debate in a solution oriented process. However, as physical presence is considered important this should not be overlooked in the platform.

In the beginning of the platform application period, there might be a need to gather stakholders physically to generate ideas and educate users to navigate the tool. Online platforms such as the the one proposed in this study can be used to define stakeholders and gather them for physical events. This could be done through facebook or via newsletters etc. Furthermore, the platform provides an oportunity for effective follow up and sharing of key findings with a broad auience. An upside to using the platform is that stakeholders can be actively engaged based on their relevancy for the platform or a platform project. It is considered likely, that the optimal process is a combination of web-based solutions and events of physical participation e.g. workshops, meetings and hearings to support the development of the platform and projects carried out through it. Physical presence can help create a protected space for the innovation to grow. The prioritization of local networks might thus be a necessity in defining the stakeholders for the platform projects.

10.4.3.2 SUBOPTIMAL MEANS OF STAKEHOLDER ORGANISATION

Besides proximity, there remains a need to engage, stimulate and organise stakeholders in an area. Greisen (2018) points out that it is difficult to mobilize citizens. People living in proximity e.g. in flats do not know each other and it can be challenging to mobilise them and there is a need to focus on this in the future. Residents need to find each other somehow, which can be described as a need for a somewhat social movement where citizens are motivated to make energy demands (Greisen, 2018). In relation to this Hasselager (2018) explains that citizen engagement is currently done via the electricity bill, where people are provided a link or an explanation as to where to learn more about e.g. energy savings. Other strategies are to provide information through brochures or the e-box. However, these have proven ineffective measures of engagement. Experience has taught that there is a need to seek out people where they are. This could for example be during events such as flea markets, market days, where employees from the municipality attend and inform citizens about relevant campaigns. This is considered a possible strategy which municipalities can focus on in the future (Hasselager, 2018). Such initiatives might be helpful when the aim is to collect stakeholders from a local area. However, it is also deemed viable to engage stakeholders in online forums to increase awareness of platform projects e.g. Facebook pages for specific municipalities, NGOs etc. and this is also a way in which place specific stakeholders can be engaged. This could be ways to gather potential stakeholders and create awareness of projects or the platform in general.

There is arguably a need to go about stakeholder organisation in a more localised way. for example, Hasselager (2018) explains that currently citizen information is not tailored the city districts, and as initiatives differ from one area to another, it is deemed viable to focus on locally tailored solutions to a greater extent than what is done today (Hasselager, 2018). Considering what has been found previously in the study, stakeholder organisation is deemed sub-optimal, due to the lack of framework e.g. for citizen participation. Engaging and organising stakeholders is an important aspect of the platform, where network has been found significant through SNM. Ensuring locally tailored solutions could be a way to make energy more tangible. If information is compiled to ensure that local stakeholders get an understanding of why the neighbourhood is of interest and what can be done on a concrete level, this is expected to have a positive effect on organisation of stakeholders which arguably promotes a viable network.

10.4.3.3 SOLUTIONS

It is clear that both proximity, physical presence and stakeholder organisation can be deemed important to the platform. The informants how this can be integrated into governance. For example, Greisen (2018) argues that when organising stakeholders, it is sensible to work with clusters of stakeholders within an area to ensure proximity and local tailoring. Especially when it comes to citizen integration (Greisen, 2018). Working with local areas is deemed viable, which is something that can be done through mapping as well, where areas of interest can be defined. For example according to Hasselager (2018) a spatial platform should be used to distribute information on political visions and goals, and the implications these have on citizens in a city district. It could enable detailed and locally tailored solutions and could be a way to integrate citizens more strategically (Hasselager, 2018). It can thus be considered viable to define geographic boundaries clearly when defining projects on the platform, to narrow down who is relevant to include for a given project: Is it a city district project, or a municipal project, should it include those affected by the project etc.? It is possible to distinguish between stakeholders directly involved in a project and those affected by it i.e. indirectly involved, and these should be included and prioritized in suitable ways. For example, in some cases, the indirectly involved stakeholder should be prioritized as directly involved stakeholders are already organised e.g. in some cases with wind energy projects, where those affected arguably need to be involved.

The more challenging barrier to the platform is the perceived need for physical presence to ensure a safe space for idea generation. This is arguably not in line with central aims of the platform of furthering a transparent process and broad inclusion. Even though the platform is designed to reach a large audience, there might be need to incorporate physical presence to some extent as physical presence is argued as important for furthering some viable learning processes which is deemed important through SNM. Greisen (2018) has had success with designing a room in Nordhavn, where all partners contribute with information and visions. It is designed to be suitable for presentations and open workshops and it is used for cocreation and production of innovative ideas (Greisen, 2018). Similar to this Venturini & Karlsson (2018) has experience with workshops for both existing stakeholders and citizens. At the workshops, participants define visions. Over the course of several hours, the models are defined, run and the results compared and discussed. It is important to gather people and discuss solutions on a common ground. When people are gathered for workshops, participants can freely ask questions and get answers, and the discussion is focused and relevant (Venturini & Karlsson, 2018). Based on this it can be argued that a successful process could be built up around online and offline phases, designed strategically to support each other. Physical presence should arguably have a clear function in the platform which could be to induce a learning effect in aspects where the platform falls short. The upside to physical presence is arguably that interaction becomes more personal whereas online interaction is characterized by more anonymous inputs. However, the platform is considered an innovative method of governance which has some strengths which are arguably lacking in traditional processes of carrying out energy projects like; reaching out to more people and making it easier for stakeholders to participate in governance. Moreover, events of physical presence such as workshops are more resource costly than processes which can be carried out on the platform. It is suggested that these events are reduced as much as deemed possible, but there is arguably need for both aspects in the process. The integrating proximity and physical presence function is summarized in ***Table 9***, along with the barriers and needs it is derived from, the proposed solutions by the informants and the related elements from SNM.

Barrier/Need	***Solution***	***Derived Function***	***Elements from SNM***
Physical presence, proximity and a safe space for idea generation is considered necessary elements for good governance. Moreover, current means of stakeholder organisation is inadequately tailored to local circumstances.	*Ensure proximity, events of physical presence and local tailoring.*	***Incorporating a local perspective where project areas are clearly defined aiming for proximity and locally tailored solutions. The platform is supported by physical presence: Meetings, hearings, workshops etc.***	*Learning* *Protected space* *Networks*

Table 9: The integrating proximity and physical presence function.

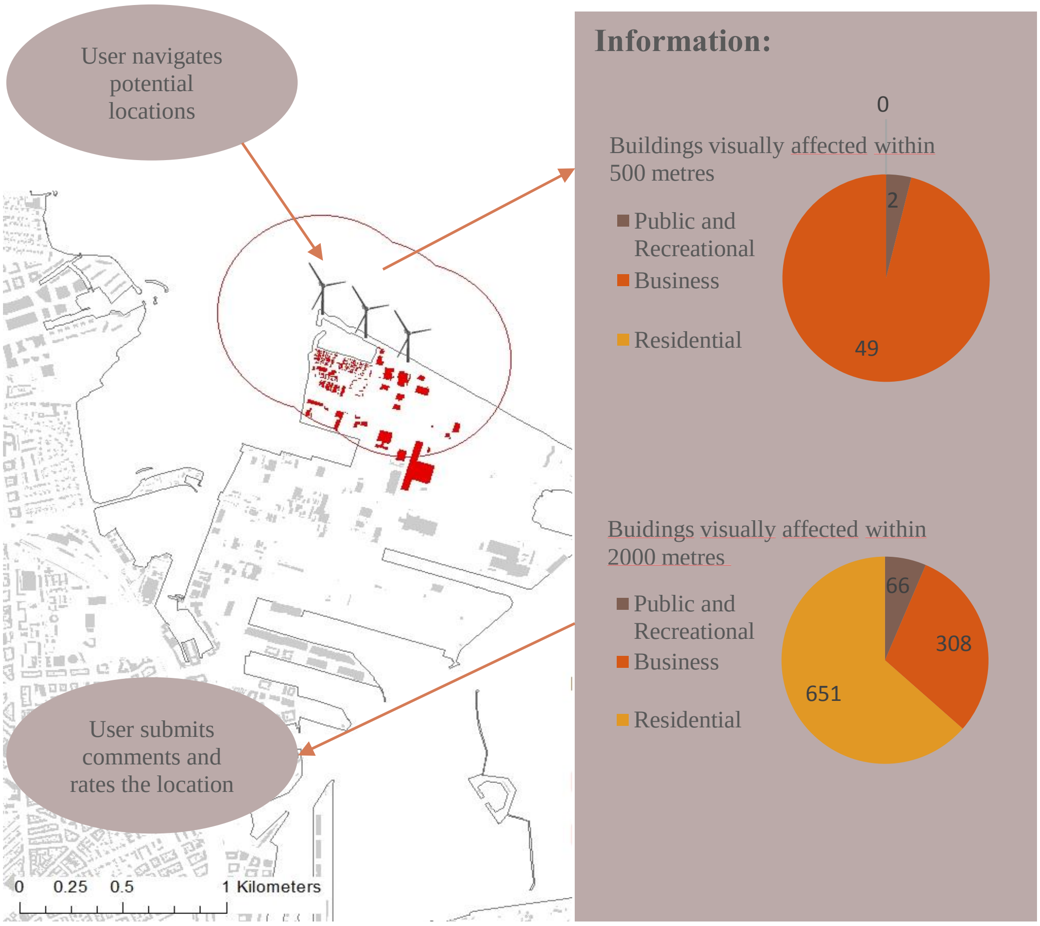
10.4.4 ONSHORE WIND TURBINES

Moving away from a theoretical perspective upon the platform, the more practical application of functions is investigated in the following by including the cases. The informants provide their insights to the respective cases, where key insights for the wind turbine case include; demographic determinants for the attitude towards wind turbines and the general debate over wind turbines. The adaptation of the case is carried out in the light of previous platform functions found in this analysis.

Hasselager (2018) sees certain challenges with using a platform in the process of carrying out onshore wind turbine projects. Wind turbines can be considered a sensitive topic, where the implementation depends ultimately on political courage. According to Hasselager (2018) when the demography is examined, the results are hard to use for anything. If wind turbines are communicated as having a negative impact on citizens, politicians will be hesitant to support such projects as their main goal is to collect votes. The dominant attitude towards energy is that it is considered the 'backyard of the city', where the technical facilities are associated with a negative impact on the local environment, so there is a need to be careful regarding how information is presented (Hasselager, 2018). This is considered a barrier to the platform where there is a defined need to further a constructive and transparent process. There is a political will to enact the voters interest and if citizens perceive projects negatively the political support falters. Adding to this barrier Greisen (2018) argues that there are indicators that place matters more than what is evident in literature and the public debate when it comes to wind turbines. Even though a business case for putting up wind turbines in Nordhavn is likely good (the city part is not expected to be developed for approximately another 40 years), there are significant barriers to such a project. Even though in Denmark people are relatively accustomed to wind turbines, the attitude towards them differs highly, which is something that becomes clear when working in the field. Greisen (2018) argues that there is no scientific basis for talking about the harm that wind turbines cause humans beyond the critical boundaries for noise and shadow effect, and thus it becomes a psychologic issue, when the turbines are negatively perceived. As a result, the politicians and municipalities who have a negative attitude generally do not want it documented as this associates with being opposed to sustainability. Moreover, Greisen (2918) argues that demographic factors have a considerable influence. Wind turbines in Nordhavn will mostly affect the north of Copenhagen i.e. wealthy neighbourhoods, and if investigated properly, the tendency is likely, that the acceptance is lower in these areas than others (Greisen, 2018). This is arguably a provocative statement to make, but it is relevant to note plausible determinants in the process of carrying out wind turbine projects which, might not be discussed openly amongst stakeholders or mentioned in literature.

It becomes evident through the informants, that the process of implementing onshore wind turbines is constrained by somewhat intangible factors, where discussion is restricted by political fear of the effect information can have on citizens. This is a barrier to be aware of when adapting the cases. It can be translated into a hesitation when it comes to integrating citizens in the process, as it can be considered a complicated task with the risk of furthering a negative outcome. Citizen participation introduces some additional complexity to planning, particularly to project responsible stakeholders, which will need to steer many different stakeholders. However, this can be considered a part of picking the high hanging fruit. The platform operates under the condition that citizens should be included, despite such a barrier. The question is how this issue is taken into account. It is not deemed optimal to withhold information. However, information can be presented in a way which is less frightening and more productive. For example, ***Map 1*** would arguably pose a risk of furthering a negative attitude, as it illustrates the consequences of onshore wind turbines as significant. Instead focus should be on engaging citizens in a way that induces a more positive and productive attitude towards wind turbines, and then politicians can be expected to follow suit. If the opportunity for politicians arises for branding themselves as green in a more transparent environment, they can be expected to act upon this. The question is how to ensure this in practise. It is a challenge to find a balance between providing information and avoiding a negative attitude, but an attempt has been made in this study. Instead of visualising the severity of the consequences of wind turbines focus is moved to providing fuel to a more positive debate whilst still increasing transparency. So, the purpose with the adaptation of the wind turbine case is to create a better understanding and a foundation for stakeholder integration and sharing benefits of the project. In an optimal scenario the platform could be used to move away from the consensus that energy is the backyard of society into more active participation of stakeholders throughout the process of carrying out an energy project.

To accommodate the negative attitude towards wind turbines it has been argued through SNM that expectations and visions need to be streamlined. One way this could be done is by creating a mutual understanding that wind turbines need to be built, the question is where these should be placed. So, for example, if information on why a number of wind turbines needed to be implemented was compiled for a broad audience along with e.g. five potential locations, a consensus that there is a need to select one of the five, could be stimulated and communicated through the platform. This could be a way to reduce negative feedback, which can be accommodated by designing the platform more or less open and ensuring a constructive inclusion. If the platform is too open and citizen inclusion non-directed, negative feedback can be expected. Therefore, it is recommended that the platform administrator pre-defines a range of potential locations for wind turbines and compiles relevant information for each case, to prepare it for a directed discussion amongst stakeholders, citizens in particular. This would be in line with pre-defining project dimensions and geographic scope which was a function found via SNM and stakeholder engagement in previous section. Based on the information, citizens could be able to evaluate more objectively which alternative is the most suitable, and what compensation is necessary for the alternative to be deemed acceptable i.e. in terms of compensation and distribution of goods. This could be done via two-way communication and maps in a directed forum, another platform function defined through SNM and stakeholder engagement.



Map 3: Adapted wind turbine case to accommodate stakeholder engagement and SNM. By integrating the BBR register types of affected stakeholders can be estimated and information can be presented in an interactive map with graphs and figures to increase user friendliness and enable comparison of the alternatives on common ground.

Continuing with the previous case of onshore wind turbines in Nordhavn a platform function can be illustrated as in ***Map 3***, where BBR is integrated and a buffer of 500 and 2000 metres from the three turbines is analysed in relation to the types of stakeholders affected in a given location. For a detailed walkthrough of the GIS approach see Appendix A: GIS Approach. This can be considered an initial sketch of how a platform could be designed for a wind turbine case, where Nordhavn could be one in a basket of potential locations for users to navigate between.

Information can be provided through interaction with a map and figures in a way which can be considered user-friendly and applicable to a broad variety of stakeholders. The information should optimally include both visual and noise implications as well as other potentially relevant factors e.g. environmental considerations and other area conflicts, to create an understanding of the selected alternatives. The function is arguably applicable in the beginning of the process of implementing wind turbines, where citizens are included already in the initial phase of choosing between locations. The process can be illustrated as in ***Figure 4***.

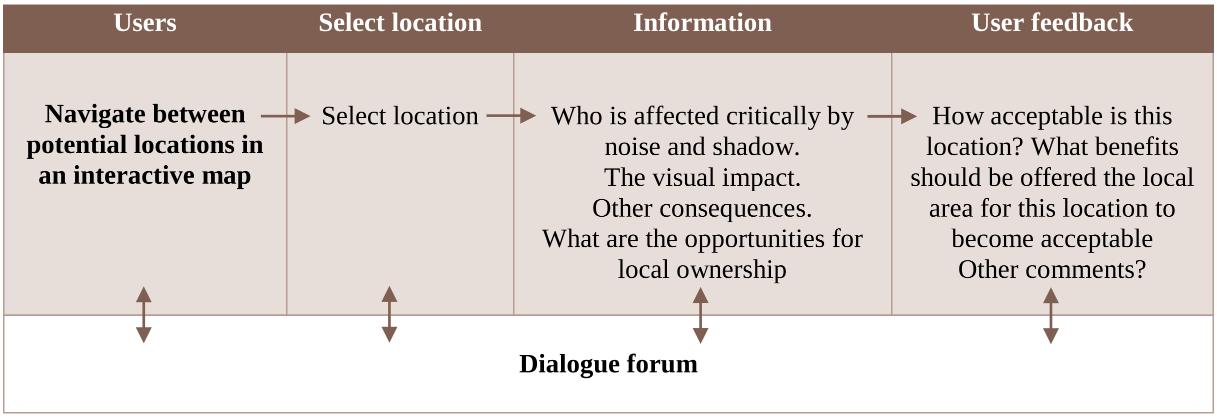


Figure 4: Practical application of platform function.

This function could arguably be presented as a more dynamic and interactive alternative or supplement to the public phases which currently comprise a considerable part of the process when it comes to onshore wind turbines. Mappin the alternatives for user feedback can enable discussion and argumentation for choosing an alternative over another. The upside to two-way communication is that users are able to get a timely and individual response to their comments instead of the traditional process of gathering all the comments and oppositions and present a combined response later in the process. It can be considered an initial platform function from which further learning of stakeholder integration can be achieved, and the platform should be adapted according to the learning effect. The learning outcome could contribute in knowledge regarding how citizens should be compensated and/or included in wind energy planning in terms of e.g. offering a share of the project or cheaper electricity from the wind turbines. Depending on the available resources, the platform could open for two-way communication. Having a dialogue forum would entail employees that needed to be hired for citizen engagement. There would be a need for a certain structuring of the discussion which could be done by adding moderators to ensure the tone and relevancy of the debate, and this would increase the cost of administrating the platform.

Such a map-based platform could provide a basis for directing the discussion onto more meaningful paths. It would arguably enable a clearer connection between the relevant information and the alternatives being discussed to make the process more transparent, and less affected by random factors. The tool could enable users to learn interactively and is expected to stimulate a more objective prioritization between alternatives as these are compared on common ground, where it could enable users to formulate arguments for one location over another. It could provide politicians and other authorities with a stronger argumentation for choosing a location to carry on with and help improve the process and make it more inclusive. When it comes to the integration of proximity and physical presence found viable through SNM and stakeholder engagement, if citizens are integrated early in the decision process there is a more solid foundation on which to shape hearings, helping direct the discussion during physical meetings. If the platform is integrated successfully, the municipalities would likely not have to spend as many resources on the process.

10.4.5 ROOFTOP MOUNTED SOLAR PV

To continue with the more practical application of the platform concept, the rooftop mounted solar PV case is adapted and further developed. The informants provide relevant insights which will be used to define potential platform functions for the case. Key insights in this case include; design of information for potential stakeholders, and strategies for stakeholder engagement, where citizens are expected to be more susceptible to invest in solar PV under certain circumstances.

According to Greisen (2018) There is a large potential in Denmark for rooftop mounted solar PV, which should be utilized, where the municipality is proposed as a key stakeholder in defining the suitable roofs for solar PV production, taking on active a role to organise and steer stakeholders as much as possible to further projects (Greisen, 2018). Hasselager (2018) also considers rooftop mounted solar PV an important aspect of the energy transition with different opportunities for size and ownership of projects, where he argues for prioritization of large rooftops e.g. sports halls and industrial buildings, gathering halls, nursing homes, schools etc. could be prioritized as they have the potential to hold large solar PV facilities (Hasselager, 2018). According to Hasselager (2018) there is a need to integrate strategies for how to engage stakeholders. The current approach to citizens engagement, is to inform them on how to save energy, where much focus is on designing information for citizens (Hasselager, 2018) but as previously appointed, current means of organising stakeholders is deemed suboptimal. Hasselager (2018) argues that it has proven effective to inform citizens that they have a consumption above average, and that ‘you as a consumer should react on this’. It is considered applicable to the study to introduce a strategy for engaging citizens with higher than average energy consumption and propose solar PV as a potential initiative for mitigating this. However, when designing this information, a challenge is proposed by Hasselager (2018), which is the fact that energy consumption data are private. A municipality cannot use these data and make them public, whereas energy companies have somewhat less strict frames for using these data. The law is adapted to protect the consumers and it is not possible to publish a map to localise an address or a road. Rather so, maps should illustrate city districts, and this is still a way to create some attention and perhaps even get the attention of individual stakeholders (Hasselager, 2018). Although this does pose a barrier to the case, mapping can still be used internally in e.g. the municipality to define potential stakeholders specifically. It would be possible to create a public version of the map that doesn't allow for pinpointing addresses which could be shared in public to create awareness. For example, a cluster analysis could be carried out in GIS to define areas with high heat consumption and suitable roofs. This is arguably meaningful when dealing with a larger case area e.g. over Greater Copenhagen which could help define some suitable municipalities and potential stakeholders to engage and is a relevant option to consider.

Another important aspect of designing information, Hasselager (2018) argues is the 'power of the example'. Stakeholders need to see that an initiative has worked elsewhere under similar circumstances with the same technology. By communicating success stories, stakeholders associate potential projects with real-life circumstances (Hasselager, 2018). Collecting and organising examples is considered a way in which information can be designed. The power of the example could thus be applied through a portfolio of similar cases on the platform. Including a portfolio can also help tap into previous experiences and involve actors with expertise in a strategic way so that it becomes relevant to the new project.

Besides ensuring that information is designed for the potential stakeholders, Hasselager (2018) clarifies that from experience there are situations where citizens are more receptive towards energy investments. Citizens are more inclined to invest in a basket of initiatives at the same time e.g. in case of house purchase or when a house needs renovating (Hasselager, 2018). Furthermore, some types of households are expected to prove easier to reach than others. For example, in housing cooperatives there is a well-established decision-making process. Here people participate in the yearly general assembly where a consultant could inform them of energy solutions which then could be voted upon by residents (Hasselager, 2018). One approach deemed viable by Hasselager (2018) is to map the buildings where the roof will need renovation soon.

To make a strategy for engaging potential stakeholders for rooftop mounted solar PV, focus could be on how and when to include stakeholders. For this, BBR and HA data is joined with the buildings of the case. A various of mapping opportunities can be related to this topic with these data and it is possible to pre-define the geographic scope and project dimensions depending on which projects are deemed viable at a given time and place e.g. where an authority pre-defines an area where there is a high potential for rooftop mounted solar PV for townhouses, apartment buildings, business etc. This would, similar to the wind turbine case, be applicable early in the project period as a way to streamline expectations and visions. To investigate one possible strategy, the demand per m^2 is calculated to locate buildings with expected poor performance.

Map 4: Apartment buildings with rooftop mounted solar PV potential where stakeholders are expected to be more open to investments.

Data indicates that the largest part of the building stock, was built between 1880-1950, where houses built after 1950 can be expected to consume significantly less per m^2. Moreover, the date where the roof can be expected to be replaced can be estimated based on construction year as well as the mean lifetime of the type of roof and thus, citizens likely to renovate roofs in the immediate future can be pinpointed.

Map 4 illustrates apartment buildings with rooftop mounted solar PV potential which have either; above average heat consumption, suitable roof age or high heat consumption and suitable roof age. For a more detailed walkthrough of the GIS approach see Appendix A: GIS Approach. As there is a large variety of options and un exploited potential when it comes to rooftop mounted solar PV, it is arguably useful to pre-define the type of project before engaging stakeholders to integrate a more strategic approach to planning. Such mapping as carried out in this study is arguably applicable as pre-analysis made by the platform administrator or knowledge institutions and could provide a foundation for designing processes carried out via the platform. A suggested platform process is illustrated in the following ***Figure 5***.

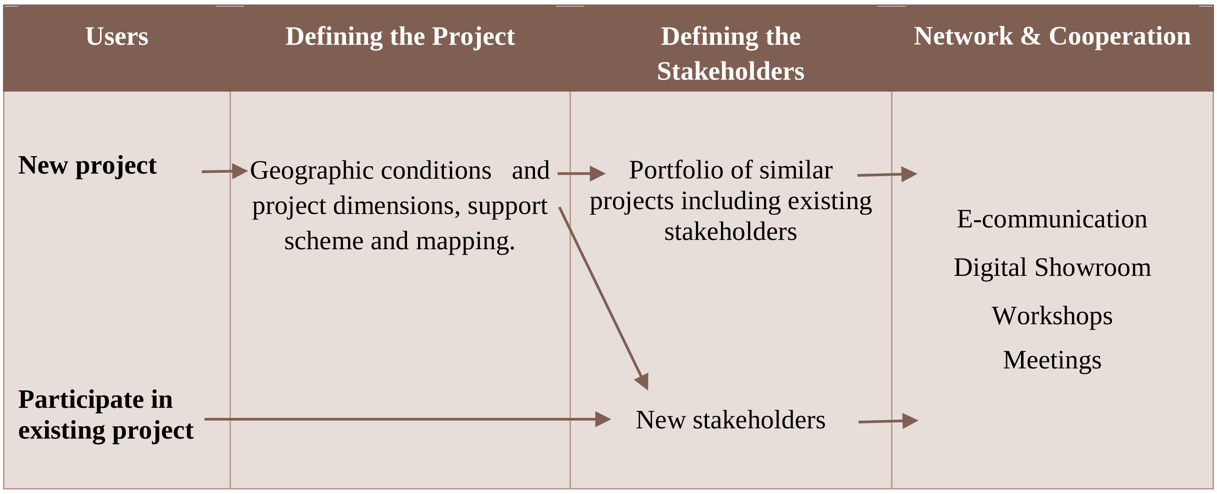


Figure 5: Practical application of platform function.

Here the platform is used differently than in the previous case, where citizens are more so included to mobilise resources. Users are distinguished as project managers who can define the project and potential stakeholders, who are defined based on their potential contribution to a project e.g. owners of viable roofs. This process is deemed applicable to a variety of stakeholder types, from owners of large roofs e.g. housing cooperatives down to individual citizens e.g. townhouses depending on the project.

In defining the stakeholders phase, the power of the example is applied through a portfolio where potential stakeholders can be defined based on the pre-definition of the project as well as including stakeholders who are deemed relevant and interested in the project. So here a platform is used to engage existing and potential stakeholders and inform them of the opportunities and organise projects. Lastly the network and cooperation phase consists of a combination of physical presence and interaction over the web deemed viable through SNM and stakeholder engagement in relation to physical presence and proximity. The nature of these offline and online phases would depend on the project e.g. proximity of involved stakeholders. Moreover, focus is on development of a digital showroom where experience and knowledge is gathered and targeted the citizens, to ensure a learning effect within the field of stakeholder inclusion and streamlining expectations and visions found viable through stakeholder engagement and SNM.

In terms of resources, there is arguably a need to get consultants to help with such possibilities and guide the users through the process which is deemed complicated, particularly to non-expert stakeholders, and there is a need for professional guidance to optimise the projects. This entails some resources being spent on this, however it is arguably an important aspect of the platform that the municipality takes on a responsibility to engage and organise stakeholders.

11 DISCUSSION

Returning to the concept of Design Thinking, it has been applied in the process of developing a platform concept. This has enabled a stakeholder-oriented approach in an iterative process focused on understanding the need, exploring solutions, and materialising a framework. This approach has been supported by scientific methods i.e. spatial analyses, interviews and a literature study. Revisiting the figure on Design Thinking from the method section, it can now be illustrated in ***Figure 6***.

It's important to note, that this is an iterative process with a continuous need to improve the understanding of stakeholders and their needs, explore solutions and adapt the platform accordingly. Therefore, the platform concept is not considered finished and should be continuously adapted through its' development and application.

Figure 6: Design Thinking as applied in the study.

Five expert stakeholders have been interviewed; one which was analysed in the context of Transition Management and four which were analysed in the context of Strategic Niche Management. The platform has been defined throughout the study, from discovered barriers, to design of theoretical platform functions, resulting in applied platform functions in the context of the cases: Wind turbines in Nordhavn and rooftop mounted solar PV for an area in Copenhagen. An alternative could have been to take a more literature-based approach. However, including experts through interviews has helped move past the knowledge gained in the problem analysis related to official power and administrative relations, to gather insights on know-how from practical experience which is hard to come by through a study of literature.

As citizen engagement has been a main focus in the study it could have been viable to include citizens through e.g. questionnaires or citizen interviews. However, at this stage of the platform development, it is estimated that more direction to the process is gained by including expert stakeholders with experience in stakeholder inclusion and cooperation. It is however deemed viable to include citizen feedback at some point to further improve the concept e.g. as part of a web-based prototype for feedback on how to make a platform interesting for citizens. When working with Design Thinking, the more stakeholders involved and the more feedback, the better the product, and the platform would benefit from having more stakeholder included in the development process, and this should be a focus in the continued development of the platform.

Throughout the study two cases are applied and continuously adapted. This is done as a measure to add some concreteness to the platform concept. The two cases are chosen based on their relevancy for Copenhagen found through the interview with the municipal informant. By applying the cases, the study is concluded by two separate definitions of platform functions applicable to different cases. It can be argued that a combined platform concept is not achieved this way, but rather two proposed concepts. The two cases differ in nature and scope where the wind turbine case more so has a focus on ensuring a positive attitude towards the project whereas the rooftop mounted solar PV case has a focus on strategies for stakeholder engagement. If other cases were applied, the resulting platform applications would most likely differ. However, it is argued that the theoretical functions defined through application of SNM and stakeholder engagement are generally applicable to energy governance Greater Copenhagen as they consist of some guidelines which can be applied for different energy projects. Another aspect of applying the cases is mapping, which is proposed as a central element for the platform. It has helped explore and illustrate possibilities for integrating spatial analyses and mapping into energy planning.

It was found in the study that stakeholder integration early in the process can be considered important. An alternative focus of the study could have been to investigate how stakeholders could be included in the construction phase e.g. in terms of compensating neighbours for noise from the construction or congestion of infrastructure caused by transporting materials or whether a platform could be used for job creation and local growth etc. Furthermore, focus could have been on how ownership and distribution of benefits could be governed through a platform. The reasoning behind the approach of the study, was to investigate how to facilitate processes which tap into the potential of digitalization and the internet as an initial investigation of what is deemed a recently emerged potential. The relevancy of this focus is arguably validated by the analyses of the study.

The two theories used in this study have had significant implications on the study. Therefore, it is relevant to consider the implication of choosing these theories. On the upside they have provided a scientific foundation for defining some central barriers and guidelines. On the downside other theories might have been relevant to include instead e.g. related to human behaviour like consumer behaviour and how to affect it, whereas theories chosen are related to governance and innovation. This is something to be aware of when considering the proposed concept and could be used in the future development of the platform.

The geographic scope of the study is limited to Greater Copenhagen derived from a relevancy for investigating the significance of urban space and local energy governance in the energy transition. The extent in which this aim was realised can be debated. The fact that innovation is important in cities should not be overlooked, and through the interviews it is clear that innovation is an important aspect of energy governance in Greater Copenhagen and might not be deemed as high a priority in other locations. Citizen inclusion is considered relevant in Greater Copenhagen likely more so than in areas with less areal conflicts and less dense population. Furthermore, the large potential for rooftop mounted solar PV in greater Copenhagen adds to making the study relevant. It can be debated how viable it is to focus on wind turbines when these will affect more stakeholders in the city, but as has been argued previously, it is on the municipal agenda and can be seen as a possibility to test and develop some new ownership models and general processes in close cooperation with neighbours. The platform is designed for Greater Copenhagen but could be applicable elsewhere e.g. in other dense areas and cities, experiencing similar barriers to those found in the study. The potential for applying the platform elsewhere can be argued. For example, when people are scattered across a large area, gathering these physically is a larger challenge than in Greater Copenhagen and here a web-based solution might be well received amongst stakeholders.

Another relevant topic which could have been analysed in debt is how an energy projects could be funded via a platform. For example, digitalization has opened for the possibility of crowdfunding. One example is the world’s largest renewable energy crowdfunding platform (in 2014) which is in the Netherlands and succeeded to raise 14.3 mio. EUR in 4 years for wind turbines where each investor became an owner (Mishra, 2014). Crowdfunding can be expected to be generally known and could be a way to empower citizens and other smaller stakeholders in line with the aims of the study. It is however, deemed relevant to take an overall perspective in this study given the lack of initiatives and learning when it comes to online stakeholder inclusion and participation in Greater Copenhagen.

It can be debated how realistic a spatial platform is, given the barriers found through the study e.g. related to transparency and the general debate of stakeholders of the energy sector, which are deemed complex and hard to overcome. With the digital age comes also great caution e.g. when it comes to documented processes and this is a barrier for innovation. Time might solve this problem as there is inevitably some insecurity linked with adopting an innovation. Integrating a web-based platform into local energy governance is considered a complex and timely undertaking. The upside to the concept proposed by this study is that it is flexible and can be adapted. It might be beneficial to integrate aspects of the platform or apply it to single projects, perhaps as a function to existing homepages such as the municipal homepage etc. It can be argued that the central proposal of this study should not necessarily be to integrate a full platform concept at once, but rather the study could be used to pave the path for thinking innovative solutions into governance e.g. in phases of public hearings and idea generation to induce e-democracy. It can be argued that the adoption of the platform depends on whether the municipality is willing to give up some power and adapt processes according to the learnings gained from stakeholder inclusion. It is deemed realistic that The Municipality of Copenhagen can be expected to be willing to do so because of their ambitious climate goals and could potentially pave the path for other municipalities or stakeholders to adopt e-democracy. As there is an ongoing digitalisation it can be expected that in the future there will be an increasing incentive for governance supported by the internet. Plans can be uploaded, and information compiled in a way which is convenient for the user in a more inclusive and transparent process. For example, The Municipality of Copenhagen is in the process of developing their own building archive where approved constructions on properties are compiled and made available (*FilArkiv · Københavns Kommune…*, 2018). Such information could be relevant when investigating potential stakeholders and is an example of how increased digitalisation creates possibilities for innovative opportunities.

Literature has been used continuously in the study supporting the development of the platform. Moreover, key findings of the study are supported by scientific literature: According to Tang & Liu (2015) effective public participation is a two-way process where the public is given access to the information such as maps and data, and then is enabled to communicate ideas and concerns as a response to this. This sort of communication is important for decision makers to understand the publics interests and concerns and to strengthen the link between the environment, people and science (Tang & Liu, 2015). Electronic documents and video clips can be uploaded, and a map-centred communication tool included to provide an understanding of the spatial factors, ensuring that users recognise landmarks (Simão et al., 2009). Through a combination of development of ideas where users are included in the process of identifying areas where energy projects would generally be accepted by the citizens so as not to waste resources on other locations (Simão et al., 2009). Users are likely to find it easier to argue objectively after having explored the problem and defined their own preferences. For example, if each user defines a feasible site for example an amount of people define areas as either: recommended, acceptable or non-acceptable chosen from predefined areas where there are no other areal conflicts (Simão et al., 2009). All things considered, there is a scientific support for e-governance, which could be investigated further as it can be deemed relevant for this study.

12 CONCLUSION AND NEXT STEP

In this chapter the results from the individual analyses are summarized, followed by a conclusion of the proposed platform concept. The chapter is ended by proposing what should arguably comprise the next step based on results from the study.

12.1.1 THE RESULTS

It is found in the problem analysis, that decentralisation and urbanisation along with advances within digitalization and the internet, provide opportunities for redistributing power amongst stakeholders in a way which is deemed beneficial for the energy transition. This provides an argumentation for investigating prospects for e-democracy further and this is done by proposing a platform for stakeholder inclusion and cooperation.

The analysis of Transition Management in the Municipality of Copenhagen is carried out to get an insight into local energy governance in Copenhagen and define which general barriers and needs a platform can be designed for. The analysis results in some defined barriers: Citizens are not deemed sufficiently included in energy governance strategies today although there is a goal of increased citizen integration. Wind energy projects have been terminated although conditions were deemed viable, and the energy sector is deemed highly complex for certain stakeholders to navigate. Moreover, some relevant needs were defined: Development partnerships are defined as applicable to the current stage of the energy transition. Mapping is deemed useful for designing information for a broader audience. Rooftop mounted solar PV is defined as having a large potential in line with aims of the municipality. The information gained from the interview is used to define the two cases applied in the study: Wind turbines in Nordhavn and Rooftop Mounted Solar PV in an area in Copenhagen.

In Spatial Analysis and Mapping, the two cases are investigated. The wind energy case was investigated in the context of the current process of implementing wind turbines. Barriers discovered are related to public resistance towards wind energy resulting in termination of a considerable number of projects. It was estimated that current means of citizen inclusion are deemed inadequate and outdated. The solar PV case is investigated in the context of energy renovations and how citizens are engaged in relation to this. Barriers found where related to the complexity of the process when integrating solar PV, where much responsibility falls on the citizen to navigate information and further the process, resulting in suboptimal projects. To demonstrate how stakeholders could be engaged via a platform, a rooftop area deemed suitable for solar PV production is mapped. It is concluded in this analysis, that a platform could be particularly meaningful when it comes to citizen inclusion in energy governance and as a result citizen inclusion is a main focus in subsequent analyses.

In the Platform Design Through Strategic Niche Management, knowledge gained until now is translated into an initial platform concept by applying SNM. The results are a set of elements which arguably should be incorporated into the design of the platform. These distinguish between, the platform itself and the projects carried out via the platform respectively. The defined elements include: Streamlining expectation and visions to create direction to the development of the platform, developing networks with the purpose of accessing valuable resources, induce learning of various dimensions, ensure niche-regime interaction so the platform is designed for the context of which it will be received and ensure a protected space for the innovation to mature and become ready for market penetration. These elements comprise the initial design of the platform, which is used for further development of the concept.

In the Platform Design through Stakeholder Engagement, the information gained from the informants and the elements found through application of SNM result in a range of barriers, proposed solutions and derived theoretical platform functions. The barriers found in this analysis are related to the design of the platform, what barriers are relevant and how a platform might assist in mitigating these. Central barriers include; the challenges of accommodating many different stakeholders via a platform, the need to ensure a common foundation on which stakeholders can enter into the debate on equal terms and a need to design a solution which enables phases or events of physical presence. The resulting functions include: Maps and two-way communication, pre-defining project dimensions and geographic conditions and integrating proximity and physical presence. Moreover, practical functions were defined, where the informants on a concrete level defined barriers and opportunities to the two cases. This resulted in proposed practical functions for the respective cases. For the wind energy case it is proposed that the process is opened up where users of the platform are allowed to compare locations on equal ground to further a more objective debate and reduce negative attitude later in the project period. For rooftop mounted solar PV a strategy for stakeholder engagement is proposed, where stakeholders deemed most susceptible to invest in energy renovations are defined and are included into projects characterised by physical and web-based phases.

12.1.2 THE PLATFORM CONCEPT

In this study a range of; elements, theoretical and practical functions are proposed for mitigating the defined barriers and increasing the chances of success for the platform. There is a need for the municipality to take on an active role when it comes to stakeholder engagement and inclusion, where information needs to be designed strategically, local initiatives need to be tailored and idea generation is opened for relevant stakeholders.

It is argued that the results of the study can be used to pave the path for integrating e-democracy as a measure to mitigate barriers central to the energy transition. It is proposed in this study that the platform could be adapted so that it is integrated into current webpages or that aspects from the proposed concept are utilised, particularly as e-governance is currently limited and there might be sense in phasing out traditional means of governance over time. Even if the platform is not developed, the work in this study still contributes to the energy transition because of its' relevancy to the sociotechnical system for which it is designed, and learnings can provide a perspective which is helpful for the energy transition i.e. which barriers are deemed significant and how these can be mitigated. For example, main barriers found in the study are not deemed technical of nature and there are indicators that when it comes to optimising the energy transition from a technical system perspective, stakeholder inclusion and cooperation are central aspects which should be of high priority, to avoid suboptimal project results, making the platform concept relevant to the general sociotechnical system of Greater Copenhagen.

12.1.3 NEXT STEP

It is considered viable to continuously follow the Design Thinking approach, where prototypes are developed, and stakeholders included for feedback. For this, meetings with web developers, designers, citizen panels etc. could be a next step where an internet prototype is developed to induce further learning processes and adapt the platform accordingly.

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14 APPENDIX

14.1 APPENDIX A: GIS APPROACH

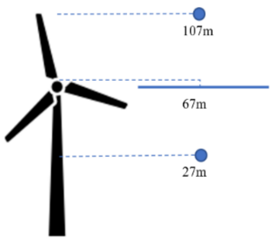
In the following the procedure for the GIS analyses will be explained. The analyses are made in Esri´s ArcMap. For both analyses an elevation map is used. Downloading this data results in several smaller squares of the layer, which are unified to one layer using the tool “Mosaic” and cut to the desired area using “Clip”.

Wind turbines in Nordhavn

Data: Elevation map from ’kortforsyningen’, buildings from ’kortforsyningen’

Step 1*: Representations of the three wind turbines are drawn, using the draw tool. Each turbine constitutes of a dot, that later will represent the top and the bottom of the wings, and a line of 80 meters, that will represent the diameter of the wings (See figure x). The turbines are placed on a line, 240 meters apart. These drawn graphics are then converted into features using the ‘Convert Graphics To Features’-tool. Using more points to represent the turbines could have given a more precise result but would also require more time. The chosen representation was deemed sufficient for this analysis.*

Step 2*: Three visibility analyses for each turbine is now made, using the created features and the elevation map as input. The tool used is called ‘visibility’ and it determines which raster cells are visible from the features. The height of the features can be modified, by adjusting “observer elevation”. First the dot-feature is set at a height of 27 meters and then of 107 meters representing the top and bottom of the wings. Afterwards the line-feature is set in between, at 67 meters representing the middle of the wings, see drawing to the right. This is done for each mill and results in 9 layers of visibility analyses.*



Step 3*: It is decided that for this analysis it doesn’t matter whether only e.g. the top of the first turbine is visible or the middle of the second and bottom of the third is. It only matters whether a part of a turbine is visible or not. The 9 layers for are therefore now combined, using the ‘Combine’-tool and reclassified to NoData for non-visible cells and a value 1 for visible.*

Step 4*: The combined visibility layer is now cut to the coastline, as only the visibility on land matters in this study. The function used is ‘Clip’, and the clip feature used to cut is the coastline layer.*

Step 5*: Now three buffers around the turbines are made using the ‘Buffer’-tool, with a distance of 500, 2000 and 5000 meters. All three turbine dots are used for input and ‘dissolved buffer’ selected, to get a buffer for the three turbines combined.*

Step 6*: The three buffers are now used to clip in the visibility layer. The resulting layers now show from which cells one or more of the wind turbines are visible from within a radius of respectively 500, 2000 and 5000 meters.*

Adding BBR and HA data

Step 7*: The combined visibility layer is converted to polygons using the tool ‘Raster to polygon’. It is then clipped with the buffers, resulting in 3 new layers which are saved for later.*

Step 8*: The new BBR and Ha data is added to the building features through the tool ‘Spatial join’. The BBR and HA data is points and is assigned to the building that completely contains it.*

***Step 9**: It is now possible to select the buildings which are affected visually by the turbines and to see data of the them e.g. what type of buildings they are. The selection is done using "Select by location" and choosing the criteria, that all buildings within a distance of 1 mm of the visibility polygon layer should be selected. Using the three different visibility layers created by the buffers makes it possible to see how the composition of affected buildings differ between certain distances.*	
Rooftop Mounted Solar PV	*Data: Elevation map and Building features from the Geodanmark dataset.*
***Step 1**: The slope of each cell is calculated from the elevation map, using the tool 'Slope' and the direction of the slope is calculated, using the tool 'Aspect'.*	
***Step 2**: To isolate the pixels suitable for solar PV, the two raster layers are reclassified. For the slope layer, values between 15-55 are suitable and therefore given a value of 1 while the rest gets assigned 'NoData'. For the aspect layer the suitable cells are oriented to the south (180º) +/- 40 degrees. Cells with values between 140-220 are given the value 1 and the rest given 'NoData'.*	
***Step 3**: A location of about 1,7 km x 1,5 km with many suitable roofs is chosen for further analysis to save computation time. The layers are cut to this area using the "clip"-tool.*	
***Step 4**: A 'Majority Filter' is used on both the slope and the aspect layer to remove noise i.e. single pixels, which cannot be used, as they are too small to be considered. The tool changes the value of a pixel if the majority of the four neighbours are a specific value. The filtering removes some of the detail, but on the other hand it saves computation time. To isolate the areas that have the right slope, aspect and are on rooftops, the following steps are carried out.*	
***Step 5:** The filtered aspect layer is clipped to the building features. This layer is then converted to polygons using the tool 'Raster to Polygon'. In this process some detail is lost, but this is very little.*	
Step 6: The slope layer is cut using the newly created polygons (with suitable aspect). The remaining cells represents areas filling all three requirements.	
***Step 7:** The new layer is converted from raster to polygon, which also creates an attribute table with the size of each area. In the attribute table all polygons with an area over 10 m2 is chosen, using 'Select by attribute', and made into a new layer.*	
Adding BBR and HA data	
***Step 8**: The BBR and Ha data is added to the building features via the tool 'Spatial join'. The BBR and HA is point data and is assigned to the buildings that "completely contains" the points.*	
***Step 9**: In the attribute table of the building layers, a new field is added called demand pr. m2. Using the field calculator, the demand from HA is divided by the total area of the building from BBR.*	
***Step 10:** Three types of residential buildings are selected, using 'select by attribute': Apartment buildings, town houses and single family houses. The selected buildings are then exported, resulting in three layers with the respectively types. With 'Select by location', the buildings in each layer with a roof area suitable for solar PV are selected and exported again as a new layer. In the attribute tables of the new layers it is now possible with 'select by attribute', to select certain buildings that have a specific roof type, age or heat demand. The goal is now to locate the people most receptive towards roof renovations. Buildings are selected based on their demand pr. m2, age and roof cladding.*	
***Step 11:** The year where the roof can be expected to be replaced is estimated based on construction year and the mean lifetime of the roof cladding. The roof cladding and construction year is included in BBR and the Table 10 summarizes the assumptions used for lifetime of the roof.*	

Note: ***If*** *the buildings are older than the mean lifetime, the roofs are assumed to have been replaced one or more times since its' construction. Buildings with e.g. tile roof, constructed around 60 years ago, are expected to be renovated soon. This is an assumption made in this study.*

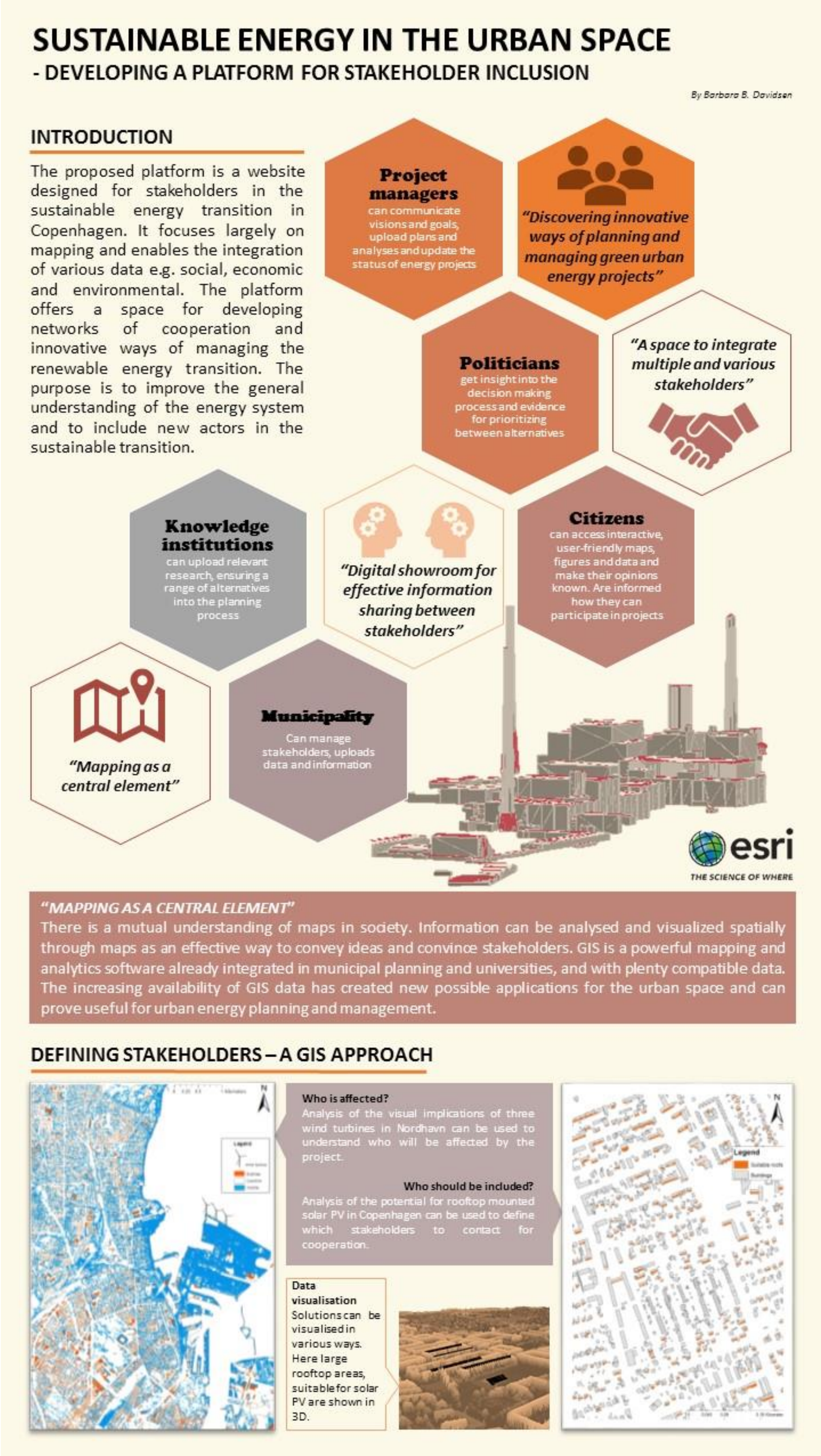
Step 12: *As the mean lifetime of roofs only provides an estimation of when it will be renovated, buildings with construction year close to the optimal, will also be included, by making an interval around the year. The size of the interval is determined individually, to get a meaningful number of houses to map. For each house type and roof type, the number of houses selected, and the construction year or interval can be seen in Table 11. the selection is performed in 'select by attribute'. The results are illustrated in Table 11. In the first category the buildings must fulfil the requirement that they have the right age and above average heat consumption. In the other category buildings who are defined fulfil the requirement that the buildings have the correct age only.*

Roof cladding	*Lifetime [years]*
Built-up (flat roof)	*35*
Felt board (with roof pitch)	*35*
Fibreglass cement, including asbestos	*40*
Breeze block	*60*
Tiles	*60*

Table 10: Estimated mean lifetime for types of roof cladding. Adapted from Wittchen et al. (2016).

	Correct age + above average demand			Only correct age		
	Roof cladding	*No. of buildings selected*	*Construction year(s)*	*Roof cladding*	*No. of buildings selected*	*Construction year(s)*
Single family houses	Tiles	4	1950	Tiles	3	1957-1959
				Fiberglas cement	6	1977-1979
Apartment buildings	Tiles	5	1951-1960	Fiberglas cement	2	1978-1979
Town houses	Tiles	11	1950	-	-	-

Table 11: Overview of selected buildings (Roof type, no. of buildings and construction year).


SUSTAINABLE ENERGY IN THE URBAN SPACE
- DEVELOPING A PLATFORM FOR STAKEHOLDER INCLUSION
By Barbara B. Davidsen
INTRODUCTION
The proposed platform is a website designed for stakeholders in the sustainable energy transition in Copenhagen. It focuses largely on mapping and enables the integration of various data e.g. social, economic and environmental. The platform offers a space for developing networks of cooperation and innovative ways of managing the renewable energy transition. The purpose is to improve the general understanding of the energy system and to include new actors in the sustainable transition.
Project managers can communicate visions and goals, upload plans and analyses and update the status of energy projects
"Discovering innovative ways of planning and managing green urban energy projects"
Politicians get insight into the decision making process and evidence for prioritizing between alternatives
"A space to integrate multiple and various stakeholders"
Knowledge institutions can upload relevant research, ensuring a range of alternatives into the planning process
"Digital showroom for effective information sharing between stakeholders"
Citizens can access interactive, user-friendly maps, figures and data and make their opinions known. Are informed how they can participate in projects
"Mapping as a central element"
Municipality Can manage stakeholders, uploads data and information
esri
THE SCIENCE OF WHERE
"MAPPING AS A CENTRAL ELEMENT"
There is a mutual understanding of maps in society. Information can be analysed and visualized spatially through maps as an effective way to convey ideas and convince stakeholders. GIS is a powerful mapping and analytics software already integrated in municipal planning and universities, and with plenty compatible data. The increasing availability of GIS data has created new possible applications for the urban space and can prove useful for urban energy planning and management.
DEFINING STAKEHOLDERS – A GIS APPROACH
Who is affected?
Analysis of the visual implications of three wind turbines in Nordhavn can be used to understand who will be affected by the project.
Who should be included?
Analysis of the potential for rooftop mounted solar PV in Copenhagen can be used to define which stakeholders to contact for cooperation.
Data visualisation
Solutions can be visualised in various ways. Here large rooftop areas, suitable for solar PV are shown in 3D.
Legend