PI-SEC

Planning Instruments for Smart Energy Communities

Report 2.1

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Sammendrag

Etableringen av Smarte Energisamfunn er sett som en viktig del i veien mot oppnåelse av de strenge miljøkrav som norske byer har satt seg. Smarte Energisamfunn, eller Smart Energy Communities (SEC) på engelsk er et begrep som innebærer at smartteknologi forenkler og binder sammen energi behov, sluttbrukere, tjenester og aktører på en mer bærekraftig måte og slik bidrar til en bærekraftig byutvikling.

I denne rapporten utforsker vi og sammenligner to eksempler på slike SEC-prosjekter: *Zero Village Bergen* (ZVB) og Furuset. I denne rapporten har vi et særlig fokus på 'ovenfra-og-ned' tilnærminger, spesielt på kommunale planprosesser og hvordan design av energiløsninger og nullutslippsbygg og –samfunn passer inn i disse planprosessene. Parallelt med denne rapporten utgis rapport '1.1 Analysis of goals and KPIs in design projects' som er utarbeidet av SINTEF Byggforsk. Disse to rapportene bør leses i sammenheng.

Ved å se på både teori og praksis, kan vi se at selv om bygningsstandarder og tekniske krav utvikler seg raskt, skjer ikke implementeringen av miljømessig visjonære prosjekter like raskt som man kunne håpe på. Funnene omfatter analyse av 14 intervjuer med aktører som har vært involvert i planleggingen av ZVB og Furuset. Selv om planleggere må forholde seg til de samme regulatoriske rammeverk, har de lagt vekt på ganske ulike verktøy og kunnskap. Mens planleggingen av ZVB i hovedsak er drevet av visjonære private aktører og forskere, har Furuset sterke offentlige drivkrefter, hvor FutureBuilt har vært avgjørende for å beholde et samlet fokus i en lang planleggingsprosess. Planleggingen av ZVB på sin side har blitt utfordret av vedvarende konflikter mellom politiske visjoner og regionale miljøbestemmelser. Regional bærekraft er håndtert av Fylkesmannen og en uttalelse fra Miljøverndepartementet rundt valget av plassering av ZVB står sentralt. Resultatet av disse utfordringene har likevel vært en del innovative tilnærminger og klare forsøk på å designe et smart energisamfunn (SEC) som tar hensyn til disse innsigelsene. Et tett bånd mellom forskere og private aktører preger dermed prosjektets form og visjon. Hovedutfordringen i planleggingen av Furuset er, i motsetning til ZVB, mangel på private investeringer og et lavt antall private interessenter i starten av planleggingen. Noe av årsaken ligger i at Furuset er oppfattet som et mindre attraktiv område dels på grunn av beboere med lav inntekt. Planprosesser har blitt forsinket på grunn av opplevde interessekonflikter mellom lokale, regionale og nasjonale aktører. Disse konfliktene, likheter og ulikheter er illustrert i figurer i denne rapporten.

Mange av funnene kan forklares med litteraturgjennomgang av forskning på norske planprosesser og verktøy for byutvikling. Teorien viser at jo høyere visjonene i et prosjekt er, jo sterkere påvirkning har sammensetning av interessentene planprosessen. Samordning blir derfor en betydelig utfordring for slike integrerte visjonære prosesser. Dette gjelder særlig ettersom høyere visjoner gjør at

planleggingsprosessene tar mye lenger tid enn antatt. Hvis pilotprosjekter skal vurderes etter andre retningslinjer enn andre prosjekter blir det også ekstra utfordrende for byplanleggere for å forstå hvordan de kan nå sine egne mål for fortetting og livskvalitet. Til slutt påpeker vi en del mangler i verktøykassen til byplanleggere i kommunene. Disse er basert på funn av utfordringer, drivere og mål, samt direkte forslag fra deltakerne som vi har intervjuet. Disse vil bli brukt som grunnlag for videre forskning og utvikling sammen med prosjektdeltakerne. Incentiver, forretningsmodeller og visualiseringsverktøy/scenariobygging er nøkkelord i denne diskusjonen om utvikling av nye planleggingsinstrumenter.

Vi vil takke for verdifulle bidrag fra alle involverte.

Dersom du har kommentarer eller spørsmål angående rapporten, ta gjerne kontakt med brita.nielsen@ntnu.no.

Summary

As high environmental goals are set by city municipalities, the support for the creation of Smart Energy Communties (SECs) is strengthened. In this report we explore and compare two examples of SEC cases, Zero Village Bergen (ZVB) and Furuset with a particular focus on municipality planning processes. By looking at both theory and practice, we see that while building standards and technical requirements evolve rapidly, the expected implementation of environmentally visionary projects is not taking place as fast as hoped by the participants.

The findings are explained in light of reviewed literature on Norwegian planning processes which show that the higher visions are, the stronger the influence of stakeholder composition. Coordination becomes a significant challenge; particularly as higher visions increase the timespan of planning processes. Further, it is difficult for city planners to understand how they can reach their own objectives of densification and living quality if pilot projects are handled as satellite projects. The report named ‘1.1 Analysis of goals and KPIs in design projects’ is published parallel to this report, and is developed by SINTEF Byggforsk. It is recommended that these two reports are read as an entity.

The findings include analysis of 14 interviews with stakeholders that have been involved in the planning of ZVB and Furuset. Although city planners depend on the same regulative framework, they have emphasized the application of different instruments during interviews. While the ZVB project is driven by visionary private stakeholders and researchers, the Furuset project has a strong public focus. ZVB have been challenged by a conflict between (national?) political visions and regional environmental regulations. This has on the positive side led to a strong partnership between researchers and private enterprise and the development of innovative tools and strategies to overcome these challenges. The case is a good example of how the design of SECs need to be better integrated with urban planning policies early on. Furuset has on their side been challenged by a lack of private investment and low representation of private stakeholders early in the process. This is due to a perception of Furuset as a low-income, less attractive neighborhood. In both cases, planning processes have been delayed due to a perceived conflict of interest between local, regional and national stakeholders in the field of sustainability and these are illustrated in two figures for comparison, together with a comparison of the tools.

These differences have influenced which tools stakeholders have chosen, yet the needs that have been identified are similar. The identified tool gap mainly describes tools that can help enable a better integration of local and sustainable urban energy systems into overall city planning and zoning, through taking into account mobility aspects and end-user preferences. While existing lessons from studied projects in the literature review offer recommendations on stakeholder composition and tools

for target setting, we have identified some areas that may need contextualized efforts. Incentives, business models and visualization are key words in this discussion on future tool development.

We would like to thank for all contributions.

If you have any questions or comments related to this report, please do not hesitate to get in touch with us by sending an e-mail to: Brita.nielsen@ntnu.no

English - Norwegian dictionary

In the report, the following translations are used [1]:

English	*Norwegian*
Building applications	Byggesak
Central government land-use plan	Statlig arealplan
City/urban planners	Byplanleggere
Cities of the Future	Fremtidens byer
County master plan	Fylkesplan
District	Fylkeskommune
Energy frame requirements	Energirammekrav
Municipal master plan	Kommuneplan
National Road Administration	Vegvesenet
Plan for land use	Arealplan
Planning and Building Act	Plan og bygningsloven
Prosumers	Plusskunder
Regional master plan	Regional plan
Regional Governor	Fylkesmann
Regulations on technical requirements for building works	TEK / Byggteknisk forskrift
Smart Energy Communities	Energismarte områder
Utility companies	Kraftselskaper
Zoning plan	Reguleringsplan

[1] A general English-Norwegian termlist for the Planning and Building Act is available on https://www.regjeringen.no/no/tema/plan-bygg-og-eiendom/plan--og-bygningsloven/plan/veiledning-om-planlegging/Bokmal-nynorsk-ordliste/ordliste-norsk-engelsk--plan--og-bygning/id462717/

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Introduction to PI-SEC

PI-SEC will deliver efficient planning instruments for integrated energy design at the neighborhood scale, qualified for Norwegian planning context in cooperation with public stakeholders. The project will provide increased knowledge about what parameters are essential for moving towards smart and sustainable energy use in Norwegian cities and how these can be linked to the planning, operation and monitoring of new or renewed neighborhoods.

PI-SEC addresses the thematic priority area *Smart Cities and Communities* and the challenge of developing effective planning instruments to improve the energy performance of built environments, and monitor corresponding progress made over time. The scope of the project combines elements of all four thematic priority areas of the EnergiX program (Renewables, Energy systems, Efficient use, and Energy policy).

The project couples planning instruments on different scales applying a multi-disciplinary approach including case studies. The project applies a multidisciplinary approach by analyzing ambitious case study projects both from the viewpoint of developers and designers and that of municipalities. To avoid sub-optimization and ensure that overall goals are met, the planning instruments will be interrelated in a way that makes it possible to transfer and aggregate information from building level, to neighbourhood, city, regional and national levels, and vice versa.

Introduksjon

PI-SEC Prosjektet kobler sammen eksisterende og nye planlegging-instrumenter på ulike nivåer for å bidra til en formålstjenlig energiplanlegging for norsk byplanlegging. Behovene blir beskrevet ved hjelp av analyse av erfaringer fra to case-studier: Furuset i Oslo og Zero Village Bergen.

PI SECs første rapporter 1.1 og 2.1 svarer på følgende spørsmål:

Hvilke mål og nøkkelindikatorer er avgjørende for en smart og bærekraftig energibruk i norske byer; og hvordan kan disse knyttes til planlegging, drift og oppfølging av nye eller fornyede nabolag?

PI-SEC vil produsere kunnskap om hva som er de viktigste parameterne når man skal gjøre norske samfunn smartere og mer energieffektive.

Prosjektet kombinerer elementer fra alle satsingsområdene i EnergiX-programmet (fornybar energi, energisystemer, effektiv bruk og energipolitikk). Kunnskapen som utvikles skal være en katalysator for å oppnå langsiktige politiske mål for å redusere energibruk og klimagassutslipp.

Hovedmålgruppen for prosjektet er norske myndigheter, kommunale planleggere og andre interessenter som har ansvar for å utvikle verktøy, mål og kriterier for bærekraftig energibruk i norske lokalsamfunn.

The knowledge developed in PI-SEC will be a catalyst for achieving long-term political goals for reductions in energy use and greenhouse gas emissions, use of local renewable energy sources, and security of supply. Having specific, agreed upon goals and key performance indicators (KPIs) is important for development of new smart energy services and products by and for the construction industry, as well as for shaping policy and legislation for sustainable development of built environments. This knowledge will also give input to standardization, certification and regulations.

The project is conducted by experienced researchers on energy use in the built environment in cooperation with a national resource group consisting of planners and decision makers of major Norwegian municipalities, as well as the Norwegian standardization organization, the FutureBuilt Program, and the Norwegian Green Building Council. The main target groups of the project are urban decision makers, municipal planning departments and other stakeholders that are developing targets, criteria, roadmaps and tools for sustainable energy use in Norwegian communities.

In addition, the project uses a European reference group of central institutes and municipality representatives from the European Innovation Platform on Smart Cities and Communities as well as the EERA Joint Programme Smart Cities. Moreover, participation in IEA ECB Annex 63[2] forms a third resource group, including also non-European partners such as China and South-Korea.

Approaches, hypotheses and choice of methods in PI-SEC

This report is one of two work packages that address the two main challenges described above:

- Work Package 1: Cross Scale Indicators in Project Planning
- Work Package 2: Planning Instruments for Municipalities

This report is the first delivery of Work Package 2, which focuses on how the municipalities should design their planning instruments to facilitate the move towards smart energy communities. Simultaneously, Work Package 1 focuses on the goals and indicators used in the planning and design of buildings and neighbourhood development projects. Together, they will answer the following main research question:

Which targets and KPIs are essential for smart and sustainable energy use in Norwegian cities and how can these be linked to the planning, operation and monitoring of new or renewed neighbourhoods?

The main means to answer this research question will be the analysis of specific case studies in the two largest Norwegian cities (Figure 1). The case study projects

[2] International Energy Agency, Energy in Building and Community Systems, Annex 63: "Implementation of Energy Strategies in Communities", project period 2013-2017, Objective to develop recommendations for effective translation of a city's energy and GHG reduction goals to the community scale, develop policy instruments, and models for cooperation and business.

have been pre-selected in cooperation with the project stakeholders. They are large (in Norwegian context) ongoing development projects with ambitious goals with respect to energy performance and related GHG emissions. Also, the researchers from NTNU and SINTEF are already involved in the planning of these projects, which will facilitate access to information.

Project name and location	Energy/environmental goals	Type and size of development	Time frame	Special issues
Ådland, Bergen	Zero GHG emissions for area, www.zeb.no	New development with 6-800 dwellings and a community centre	2015-2020	Local renewable energy and electro-mobility
Furuset, Oslo	Climate neutral district centre, www.FutureBuilt.no	Upgrading of suburb from the 1970's with 9500 inhabitants	2010-2020	Energy strategy plan and GHG accounting analysis

Figure 1: Case studies in PI-SEC

The other main methodology in PI-SEC will be interdisciplinary workshops between the researchers, international experts, and professionals from the municipalities and stakeholders in the case study projects:

- National workshops with the representatives from the municipalities and other organizations participating in the project. This will include a kick-off workshop to further specify sub-goals and distribution of work, and 3-4 workshops per year exchanging project results, knowledge and experiences between the researchers and members of the national resource group.
- European workshops in the City Advisory Board (municipal representatives) of EERA Joint Programme Smart Cities, to promote alignment and feedback of Norwegian results with European progress.
- International workshops within IEA ECB Annex 63: Implementation of Energy Strategies in Communities.

Each of the main research tasks will be divided into 4 subtasks to answer more specific sub-questions related to the overall research question:

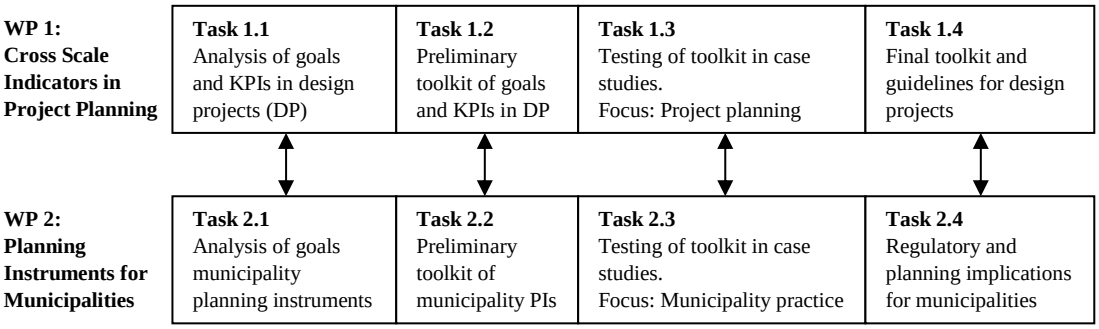

Figure 2: Illustration of the work packages and related tasks and work flows.

This report includes the outputs for Task 2.1: Analysis of municipal planning instruments. The task is developed in close cooperation with Task 1.1. Together, they aim to answer the following research question:

Research Question 1: What are the main drivers and challenges experienced in the PI-SEC case projects? What is the definition and scope of the PI-SEC case

projects, and how are these supported by / embedded in planning instruments? How do the state-of-the-art energy-related targets, planning instruments and KPIs perform on different scales (buildings, neighbourhood, district, city, country)?

Task 2.1 is based on individual interviews of municipal and other experts involved in the PI-SEC cases to identify the main drivers and challenges experienced in the planning and implementation of these neighbourhood projects. Complementary to interviews, document analysis is performed of PI-SEC case documents such as tenders, meeting minutes and strategic programmes.

Task 1.1, delivered in a parallel report by SINTEF Byggforsk, collects, structures and analyses existing definitions, targets and KPIs in the case studies to see if they are practical to implement and adds value to the transformation process. It also explores underlying value systems for targets and indicators and analyse technical implementation of the indicators. It also includes analysis of energy-related KPIs, targets and visions of Smart Cities and Communities from documents related to ongoing Norwegian, EU and international projects, including sustainable neighbourhood development projects (worldwide, but focus on Europe), environmental assessment schemes, and standardisation work. The KPIs are structured according to scale of application (building, neighbourhood, region, city and country), supported values, and alignment with overall Smart Cities and Communities definition(s).

Background and status of knowledge

PI-SEC addresses two main challenges towards smart energy communities:

- The need for cross-scale indicators for setting goals and measuring progress
- Supporting the implementation and integration of these indicators in planning instruments

This report is part of the work on the implementation and integration of indicators in planning instruments, or more fundamentally the way in which the drivers and challenges that the indicators address can be integrated in the municipal planning instruments in Smart Energy Community projects. The report provides an overview of the state of the international art on the topic, as well as an analysis of the two Norwegian pilot cases, to identify the main stakeholders, drivers and challenges experienced in the planning and implementation of these neighbourhood projects, and the tools used for addressing them. The report

Bakgrunn og status

PI-SEC retter søkelys på to hovedutfordringer i planleggingen av smarte energisamfunn:

- Behovet for tverrgående og skalerbare indikatorer for målsetting og oppfølging
- Arbeidet for å integrere disse indikatorene og målsetningene bedre i planleggingsinstrumenter.

Erfaringer fra tidligere prosjekter om smart og bærekraftig energibruk har ennå ikke blitt overført til planleggingspraksis i Norge. Selv om det finnes indikatorer og verktøy, kommer det frem at det ikke er klart hvordan disse skal integreres, og det er lite kunnskap om hvordan kommunene kan lære fra forskjellige prosjekter knyttet til smarte energiløsninger.

Konseptet *smarte byer* kan defineres på et antall ulike måter. Byggesteinene i smarte-byer-konseptet er forskjellige fagspesifikke og tverrfaglige tilnærminger som kan utføres i samarbeid på ulike nivåer: fra smarte bygg til smarte nabolag og smarte byer. Smarte byer kan videre defineres som byer som mobiliserer og bruker tilgjengelige ressurser, inkludert men ikke begrenset til sosial, kulturell og finansiell kapital, naturresurser, informasjon og teknologi.

Denne rapporten er en del av arbeidet med å utvikle indikatorer og planleggingsinstrumenter som kan fremme implementeringen av Smarte energi-prosjekter.

Også økt styring ovenfra kan sees på som et behov for å sikre fremgang i smarte energiprosjekter. Dette synet på *smart* er i tråd med erfaringene fra kommunene som er involvert i PI-SEC prosjektet. Videre er det viktig å ta hensyn til at spesifikke mål og handlinger varierer fra prosjekt til prosjekt. Dermed fokuserer denne rapporten på å utforske mål og innflytelse blant de ulike aktøren i Furuset og ZVB-prosjektene. Grunnlaget for utvikling og anbefaling av nøkkelindikatorer (KPIs) er utforsket i oppgave 1.1 som utføres av SINTEF Byggforsk og leveres i en parallell rapport.

serves as a presentation of the status quo in the pilot cases, and points out potential directions and topics to be discussed in the upcoming work and reports in PI-SEC.

Before it is possible to discuss Smart Energy Communities in a Norwegian context, a few concepts need to be clarified. While "smart" and "sustainable" are keywords in today's urban planning debates, research and practice, these phenomena are used in different ways by different urban stakeholders, as well as researchers in different fields, creating a sense of confusion (de Jong et al., 2015). Even on a European level, there is no commonly accepted framework for defining smart cities and smart city projects (Manville et al., 2014), EIP, 2013, EIP, 2014). On the other hand, there are many European projects already utilising a variety of operational definitions, such as CITYKeys[3] and Transform[4].

In order to address the cross-scale nature of PI-SEC, it is important to look at the conceptualisation and relevance of "smart" on these different scales: from buildings, through communities, to cities.

The concept of "smart buildings" is not commonly used in Norway, but has been explored in some research projects by NTNU and SINTEF, e.g. the *Smartbuild* project (Andresen et al., 2007) and the *Intelligent Facade* project (Aschehoug et al., 2005). Here, "smartness" was explored and defined in several ways, including focus on intelligent control systems and building components reacting to users and the environment while optimizing energy performance, and use of intelligence in design processes with cross-disciplinary knowledge. Smart concepts for district and city scales have only recently started to be explored in Norway, for example in Stavanger's *Triangulum*[5] or Trondheim's *Carbon Track and Trace*[6], both European funded projects.

Smart energy systems and communities are an important part of climate change mitigation efforts, as they are a way to reduce energy use as well as decrease the carbon footprint of energy generation (SET Plan, 2014). While the latter has a smaller local significance in Norway, local energy systems still receive a lot of attention in the solutions investigated and implemented around the country.

While on the building scale, the conceptualisation of "smart" remains mostly technical, city planners and stakeholders have a more diversified view on the topic. Based on a review of needs in European cities, smart city projects are useful for cities if they tackle social issues and make the city more efficient and sustainable, more competitive and financially robust (CITYKeys D 1.1). In line with this finding and the preference of the municipalities involved in the PI-SEC project, this report considers "smart" as coupled to sustainable development, including its social, environmental and economic aspects. Our aim is to enable municipalities to harmonize their diverse sustainability targets while being able to successfully

[3] http://citykeys-project.eu/
[4] http://urbantransform.eu/
[5] http://triangulum-project.eu/
[6] http://www.carbontrackandtrace.com/

implement Smart Energy Communities. Furthermore, and in line with the findings of CITYKeys, we also consider governance as a core issue for the implementation Smart Energy Communities.

Accordingly, one of the definitions that is used as a starting point in this report is based on the ongoing work in the CITYKeys project. Here, the concept smart city is defined as "a city that efficiently mobilises and uses available resources (including but not limited to social and cultural capital, financial capital, natural resources, information and technology) for efficiently

- improving the quality of life of its inhabitants, commuting workers and students, and other visitors (people)
- significantly improving its resource efficiency, decreasing its pressure on the environment and increasing resiliency (planet)
- building an innovation driven and green economy and prosperity
- fostering a well-developed local democracy (governance)." (Bosch et al., 2016, p. 6)

The building stones of smart cities are smart city projects, which can be executed on the building, neighbourhood or city levels, and which shares the same characteristics as smart cities, plus

- "actively engages citizens and other stakeholders,
- uses innovative approaches, and,
- is integrated, combining multiple sectors." (Bosch et al., 2016, p.6).

However, this definition of "smart" does not directly relate to the energy system. Therefore, we also draw on work form the FP7 Transform (TRANSFORM, 2015) project, which defines smart energy cities as:

"[…] highly energy and resource efficient, and is increasingly powered by renewable energy sources; it relies on integrated and resilient resource systems, as well as insight-driven and innovative approaches to strategic planning. The application of information, communication and technology are common means to meet these objectives."

The Smart Energy City, as a core to the concept of the Smart City, provides its users with a liveable, affordable, climate-friendly and engaging environment that supports the needs and interests of its users and is based on a sustainable economy."

These definitions are very broad and do not specify the exact goals and targets that municipalities might try to achieve with the implementation of smart energy communities. This is, to a certain extent, on purpose. There is a common aim from the cities to create a good living environment for their citizens while considering the effects on the environment and the economic consequences, but it is important to keep in mind that the particular goals and actions are different from region to region, country to country, city to city, or even from project to project, and that there

is no one-size-fits-all approach (Horst et al., 2014) . Therefore, in this report we also tried to gather an understanding about the goals that are the most important for the involved stakeholders in each of the projects.

Cross-scale indicators for Smart Energy Communities

Smart energy communities require decentralized energy generation with buildings as interactive nodes of larger networks of energy exchange with other buildings and the utility grid; interactions between mobility and energy systems; and enhanced localization and land use planning for smart energy and mobility. However, there is no set of energy indicators that links lower level (buildings, neighbourhoods) to higher level (city, region) indicators. There is insufficient knowledge on how indicators contribute to overall goals of smart sustainable energy use, and how indicators on the different levels are or could be interlinked. There are unsolved questions related to how to set system boundaries for calculating, measuring and aggregating energy credits and GHG emissions with respect to time. Cross-scale indicator sets would help avoid sub-optimization, aid aggregation of results, and improve measurement accuracy at higher levels.

In Norway, most R&D, incentives, standards and regulations on energy efficiency of the built environment have so far emphasised individual buildings. The building code sets requirements with respect to maximum energy demand per m2 of floor area and minimum requirements regarding renewable energy use. In 2012, the Energy Performance Labelling system was introduced, including benchmarks for delivered energy to buildings. Also, new voluntary standards for low energy and passive house buildings have been introduced. In 2012, the Norwegian Green Building Council introduced *BREEAM-NOR* for new buildings and major renovations, including criteria for energy efficiency, low carbon energy supply, and GHG emissions of materials. The *Research Centre on Zero Emission Building*, *ZEB*, (www.zeb.no) and the *FutureBuilt Program* (www.FutureBuilt.no) are currently realising several pilot building projects. These projects have high ambitions with respect to reducing GHG emissions from buildings. On the neighbourhood and district levels, *the Norwegian Green Building Council* is currently adapting *BREEAM Communities* to the Norwegian market, and the international version is being tested in a few pilot projects. On the city level, the national program *Fremtidens byer* (*Cities of the Future*), has developed a set of criteria for pilot projects (Ministry of Environment 2013). The Smart Cities and Communities concept has only recently been introduced in Norway, and has mainly been used by municipalities, electronics and IT-companies. However, overall, there are few and vague common definitions of Smart Cities and Communities, and corresponding energy-related KPIs are not very detailed.

A wide range of European and international research, demonstration and innovation projects deal with smart and sustainable energy use at neighbourhood, city and country scales, several with participation by NTNU and SINTEF. The experiences from these projects have not yet been transferred to Norwegian planning practices.

Drivers and challenges in the planning and implementation of Smart Energy Communities

As important as it is to define the right set of indicators for the planning and implementation of smart energy communities, it is equally necessary to ensure that these indicators can be and are integrated in the city processes (Bosch et al., 2016). There are strong barriers hindering the implementation of climate change mitigation strategies (including smart energy solutions), and harmonising and integrating actions in different areas are necessary for overcoming these difficulties (IPCC, 2014).

There is little empirical evidence to support how working with smart energy communities can be embedded in daily municipal practice, and how the choice of the appropriate indicators can improve overall performances in short and long terms. There are many demonstration projects on (near) zero emission/energy buildings and neighbourhoods, documented for example in the CONCERTO programme[7] and more recent commitments in the European Innovation Platform on Smart Cities and Communities[8] as well as in Annex 63[9] of the International Energy Agency on the implementation of energy strategies in communities. However, there is still little evidence to support how a municipality can learn from isolated urban innovations to large-scale, replicable solutions that support a low-carbon transition.

This lack of established means of learning is apparent when investigating specific neighbourhood development processes. Experiences in a range of Norwegian and European projects (Bohne et al., Narvestad, 2010) show that they often were the result of specific champions in the organisation that push a project across departments and shifting project phases and constellations (Narvestad 2010). In the framework of the European project *Near Zero Energy Neighbourhoods*[10], a comparative study between Norway and Sweden indicated that lessons from (renovation) projects are not being transferred into policy decision making processes; in cases where this does happen, early communication, dialogue and information are indicated to be success factors for validation of targets, as well as reference to similar project examples, and follow up after project completion by means of workshops and training (Lindkvist et al., 2014).

PI-SEC will address this gap and seek to improve the implementation of Smart Energy Communities in Norway by reviewing international experiences and specifically targeting the needs of the two pilot cases.

There is a broad range of literature on the classification of challenges and barriers in neighbourhood development projects, as well as on energy rationalisation. In this report, we use the classification from FP7 ZenN (Karlsson et al., 2013) as a point of departure. However, studying the two pilot cases, it became increasingly clear

[7] http://www.concertoplus.eu/
[8] http://ec.europa.eu/eip/smartcities/
[9] http://www.annex63.org/
[10] http://www.zenn-fp7.eu/

through our assessment of status quo that there are significant barriers affecting the flow of knowledge, influence, responsibility and aspirations in relation to the energy rationalization and supply at community and neighborhood level. These ‘external’ factors slow down the implementation of smart energy communities. Therefore, we have decided to use the category of political/institutional barriers as defined by Langlois-Bertrand et al.(2015) instead of legal/organizational barriers.

Methodology

The overall methodology is based on the analysis of two cases of smart energy community plans: the case of the Furuset neighbourhood in Oslo, and the case of Zero Village Bergen in Ådland, Bergen.

The methodology is divided into two distinct but interrelated parts: (1) the analysis of the cases, and (2) the establishment of the state of the art based on international and Norwegian practice in planning and implementing projects with similar ambitions and, if possible, context (Figure 3).

As a starting point we will refer to context in this report as the geographic, political and legal landscape in which the stakeholders navigate. Contextual factors are also a topic that is addressed in the interviews. The definition and relevance of 'context' will therefore also be discussed in the conclusions, based on the stakeholders' view on contextual issues.

Below is a detailed description of both parts, as well as a figure explaining the course of the research and the interrelations between (1) and (2).

The findings presented in this report is based on analysis of data from desk studies as well as from primary data collection.

Primary data has been gathered through 14 in-person interviews with involved stakeholders in each case. These participants have been selected through a selective snowball sampling approach. This means that the participants were selected based on recommendations from other participants under the selection criteria that they had to have experience-

Metode

Funnene som presenteres i denne rapporten er basert på analyse av primærdata både fra internasjonal og norske planleggings- og implementeringsprosesser, samt primærdata-innsamling fra de to casene: Furuset og ZVB.

Primærdata inkluderer 14 intervjuer gjennomført med aktører fra offentlig og privat sektor, med kjennskap fra planleggingen av prosjektene. Vi valgte deltakere basert på anbefalinger fra prosjektledere og utvidet ettersom vi fikk nye anbefalinger fra intervjuobjektene – dette kalles snøball-metode. Hver deltaker ble intervjuet basert på hans eller hennes daglige arbeidserfaring og kunnskapsgrunnlag. Formålet var blant annet for å identifisere utfordringer i planlegging og gjennomføring av SEC-prosjekter og for å kunne forstå forholdet mellom teori og praksis i kommunale planleggingsinstrumenter relatert til SEC.

Sekundærdata ble videre gjennomgått parallelt med den primære datainnsamlingen og analysen. Vi har gjennomgått ulike PI-SEC dokumenter samt rapporter fra tidligere og pågående internasjonale og norske prosjekter, for å vise litt av det teoretiske omfanget og dets relevans.

For å sammenligne(Van Maanen, 1995) informasjon fra ulike kilder, ble både dokumenter og intervjuer analysert og kodet parallelt for å belyse hverandre.

based knowledge related to the planning process of the individual case (ZVB or Furuset). The interviews lasted between 45 and 75 minutes and were transcribed verbatim. The transcripts were then first analysed with a highlighting approach(Van Maanen, 1995) and secondly with focus on the following targets:

- Identification of drivers/objectives and challenges in the planning and implementation of neighbourhood projects. Each stakeholder was interviewed based on their day-to-day work experience and knowledge about the specific case.
- Identification of energy-related goals and their potential relation with indicators. The purpose was to look for input on non-technical indicators yet the questions were open.
- To understand perspectives on the definition and scope of the projects
- To understand municipal planning instruments in theory and practice; with the objective of creating an overview as well as describing the relevance of municipal PIs in relation to the project's definition and scope

During the analysis, a combination of predefined and emergent codes was used, addressing the topics that were necessary to address according to the aim of the research (e.g.: drivers, challenges, needs, instruments, etc.), as well as topics that were brought to the researchers' attention during the collection and primary analysis of the data.

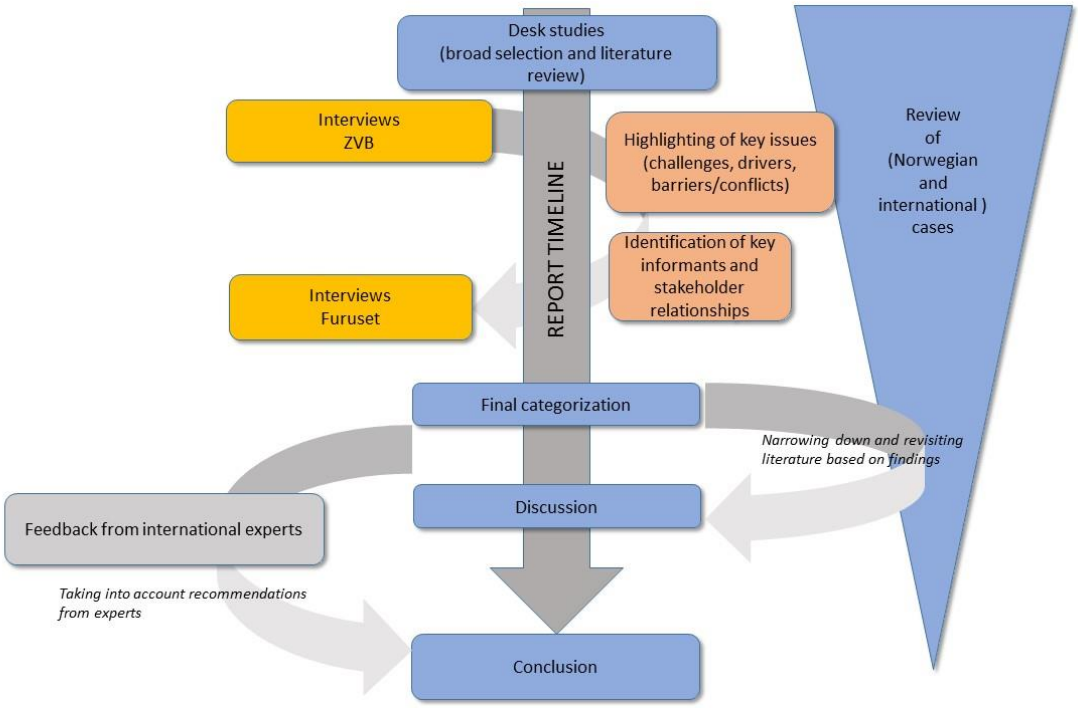

Figure 3: Research design for report 2.1

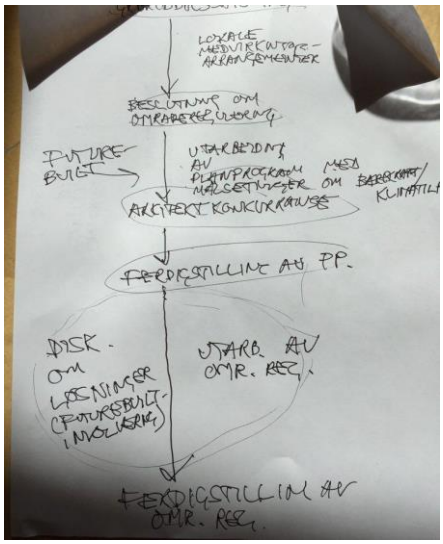

Figure 4: Timeline drawn by participant (graphic elicitation)

The interviews further applied a graphic elicitation approach (Bagnoli, 2009, Crilly et al., 2006), asking the participants to draw a timeline where they described the chronological order of the planning process and roles. This approach is useful to communicate processual insights and ensure validity in the interpretation of sequence and relevance (Bagnoli, 2009, Crilly et al., 2006). The interviews took place at a neutral setting and in the work office of the participants at the extent possible. An additional purpose of the interviews was to find indications of which topics are relevant to pay particular attention to when conducting an international case review.

Secondary data has been reviewed parallel to the primary data collection and analysis. The secondary data includes a review of PI-SEC project documents (zoning regulations, municipal plans, official communication between stakeholders, meeting minutes, reports, etc.), as well as reports from prior and ongoing international and Norwegian projects. The review of the latter reports supported the creation of this report by providing an external perspective and a basis for comparison. It helped identifying “common” and “case-specific” issues in the PI-SEC cases. The projects reviewed were selected based on the recommendation of experts, and especially of the international advisors of the PI-SEC project. The documents gathered were analysed and coded with the same approach and codes as the interviews. The aim was to triangulate(Guion, 2002) the information gathered from various sources. Thus, the literature review helped to establish sets of stakeholders and their respective drivers, challenges, goals, indicators and available as well as applied PIs.

Review of relevant Norwegian and European projects

In order to gain an overview of the organisation of processes, the stakeholders involved, as well as challenges and drivers encountered during the planning and implementation of smart energy communities and other similar projects (such as zero or near zero energy neighbourhoods), a review of Norwegian, European and international projects have been conducted. This chapter presents the findings of the review.

Document	Number of reviewed development projects	Location of reviewed development projects
Narvestad, 2010	4	Norway; focus on redevelopment
Horst et al., 2014	4	Europe; focus on renovation/extension of existing neighbourhoods
Karlsson et al., 2013	5	Europe (incl. Norway); focus on renovation

Figure 5: Overview of reviewed projects

The projects reviewed have in common that they all focus on neighbourhood or building developments with significant energy ambitions. Some of them focus on the reduction of energy use, while others also consider energy generation. All of the sites are situated in Europe, with five of them being in Norway. Two of these (reviewed by Narvestad (2010)) are of specific interest for PI-SEC, as they are situated in the same cities as the PI-SEC cases, so they can provide a basis for comparison between processes running in the late 1990s – early 2000s and today. Most of the buildings and neighbourhoods have finished construction, but some of them are still in the design or implementation stage.

The experiences from the projects were analysed with a focus on the following topics: process, stakeholder participation, drivers, goals, synergies, challenges. This chapter will present the experiences under each of these topics, with highlighting important cross-cutting issues where relevant. Since the projects had different focus, it is not a given that all information was available about all of them. Therefore, the source of information is noted under each of the headings.

It is important to note that the desk study findings presented below are focusing on providing an introduction to the extent of existing knowledge, while matching theory and practices with the specific challenges and needs in the case studies is a part of future research Tasks 2.2 and 2.3.

Process

A case review of 4 Norwegian cases (Narvestad, 2010), the final cRRescendo report (Horst et al., 2014) and a review of development processes under the FP7 funded ZenN project (Karlsson et al., 2013) provide some important insights about the planning process of neighbourhoods with high environmental and energy ambitions. These insights highlight the benefits of long negotiation processes, as well as underlining differences between refurbishment projects and new neighbourhood developments.

Longer negotiation processes allow for the consideration of the balance between ambition, will, costs and practicalities when deciding on goals, especially due to the long lifespan of urban developments. This is even more emphasised in the case of refurbishment projects, where the involvement of residents has a stronger emphasis in order to ensure that they are on board and will not hinder the implementation due to unexpected costs or disagreements with details of the plan. Furthermore, the existing building and neighbourhood structure poses technical challenges (Horst et al., 2014).

Experiences from Milton Keynes (Horst et al., 2014), an expansion of a 1970's urban development project, also show that creating the possibility for actors to collaborate early in the process was important for the success of the development. In this particular project, the real estate developer was considered the most important stakeholder.

The long lifespan of projects has another significance for ambitious urban developments. It is vital to ensure that the project doesn't lose significance for the advancement of research and practice, while also making sure that the goals set don't scare off potential stakeholders. This suggests the benefit of setting goals that gradually increase during the implementation of a large-scale development (Narvestad, 2010).

Stakeholder participation and environmental concerns

The reviewed cases (Horst et al., 2014; Narvestad, 2010) suggest that stakeholder participation and the role of specific stakeholders in the process significantly influences planning processes and final outcome. It can be useful to divide stakeholders broadly as private and public stakeholders. In the Norwegian context, public stakeholders typically include Statsbygg[11], municipalities, The Norwegian State Housing bank (Husbanken), ENOVA, etc. The private sector stakeholders that have most influence on the planning process are the developers.

However, there are important differences regarding the role and importance of the specific stakeholders in each case. These differences reflect the differences in the ownership and initiation of the projects. Based on this aspect, the projects

[11] Statsbygg is the Norwegian government's key advisor in construction and property affairs, building commissioner, property manager and property developer

investigated can be seen as belonging under two main categories: they are either initiated by public bodies and are situated on publicly owned property, or they are initiated by private companies and are situated (mainly) on privately owned ground. The two types of projects share some similarities: they have high environmental ambitions, and they involve similar groups of stakeholders and interests. However, the role and relationship of the stakeholders is fundamentally different. The table below outlines the main roles played by some of the above-listed stakeholders in the projects investigated by Narvestad (2010).

Public stakeholder driven projects: Statsbygg played a central role in the public stakeholder driven projects. Statsbygg is a govnerment managed enterprise within the Ministry of Municipality and Modernization (Kommunal- og moderniseringsdepartementet). However, the level of involvement of municipalities and Statsbygg differed in each of the projects. The private actors involved had to follow the environmental demands that have been set in the zoning plan (reguleringsplaner) and the environmental monitoring program (miljøoppfølgningsprogram).

<table>
<tr><th colspan="2">Stakeholder</th><th>Pilestredet park (Oslo)</th><th>Fornebu (Bærum)</th><th>Strandkanten (Tromsø)</th><th>Damsgårddsundet (Bergen)</th></tr>
<tr><td rowspan="4">Public</td><td rowspan="2">Statsbygg</td><td>Owner, developer of buildings and outdoor areas,</td><td>Owner, involved in high level planning, not in the development of the buildings.</td><td colspan="2" rowspan="2">Not involved</td></tr>
<tr><td>Inspector in relation to the environmental demands in the building process</td><td>Drives environmental demands</td></tr>
<tr><td rowspan="2">Municipality</td><td colspan="2" rowspan="2">Involved (different levels)</td><td colspan="2">Managing role
Owns only schools and infrastructure in the area</td></tr>
<tr><td colspan="2">Provide ideas for environmental and sustainability demands that are relevant for the area, and to connect the private actors with relevant networks</td></tr>
<tr><td colspan="2" rowspan="2">Private (developers)</td><td colspan="2" rowspan="2">Follow the environmental demands formulated in the “reguleringsplan” and the “miljøoppfølgingsprogram”.</td><td colspan="2">Developers and property owners</td></tr>
<tr><td colspan="2">Initiator of environmental demands</td></tr>
</table>

Figure 6: The role of stakeholders in development processes (based on Narvestad, 2010)

Private stakeholder driven projects: private actors were the initiators for the development. In these cases, also environmental demands are controlled and targeted first and foremost by the private initiators. Private stakeholders draft suggestions for zoning plans (reguleringsplaner) and perhaps also other documents where they express these ambitions. In these cases, a constructive dialogue between private and public actors is even more important, as the public actors have a much more limited role and a limited set of tools available for them to ensure that the stated ambitions are met. In these latter projects, the role of public stakeholders is to:

- Inspire environmental and other sustainability ambitions, suggesting actions and connecting the private actors to networks in order to ensure that the ambitions are fulfilled.
- Overall planning work in the area. Facilitating participatory planning process. In this work, the municipality has an opportunity to utilise interesting participation tools, for example games.
- However, even when their influence on the built environment is limited (no publicly owned outdoor areas, only responsibility in communication and infrastructure), the municipality can play a role. Initiation of large scale infrastructure, for example as pedestrian bridge, can improve the overall quality of the area and contribute to the overall ambitions.

Experiences from other projects (Horst et al., 2014) show the importance of connecting parties in the development process that are able to amplify each other's effects, and emphasise the importance of personal involvement in sustainable development. Again, it is relevant to return to the positive influence of enabling stakeholders to meet and connect early in the process. This extends to communication between architects and engineers, municipalities and housing corporations, developers and residents. Mutual understanding between these stakeholders is considered as very beneficial for the overall process. Demonstrators for the FP7 ZenN project also organised their process along these guidelines.

Goals and drivers

Even though all of the reviewed cases had a focus on high environmental or energy-related ambitions, it is clear that these are not the only foci in the development process. The following figure summarizes the most common central goals highlighted by Narvestad (2010).

	Bærum (Fornebu)	Oslo (Pilestredet park)	Tromsø (Strandkanten)	Bergen (Damsgårdssundet)
Transport	√	√	√	√
Energy use	√	√	*Energy supply*	√
Indoor climate	-	√	√	√
Emission/pollution reduction	√	√	-	√
Waste treatment	√	√	√	-
Quality of outdoor areas	-	√	√	√
Material use	√	√	-	-

Figure 7: Diagram of common goals in development projects (based on Narvestad, 2010)

The identification and selection of goals provide an important basis for the development. Nevertheless, identification of a set of goals is not sufficient for understanding the path that the development process will take. The specific solutions depend on the specificities of the area and the process, and can therefore be different even in projects where the set of goals is similar. This shows the importance of the further negotiation process, where the solutions to be implemented are discussed and decided in detail.

When discussing the identification and implementation of goals, the work of Narvestad (2010) highlights an important difference between projects initiated by public and private stakeholders. This difference is related to the tools and processes that are available or typical in the planning and negotiation process. In projects initiated by private actors on privately owned property there are fewer regulative tools available for the municipalities for the implementation of environmental goals. Therefore, in these types of projects it is much more important that the private actors themselves set goals that are higher than the national standards. The projects show that supporting/improving the profile of the project and the company can drive private actors to set such goals.

The investigations of Narvestad (2010) also point out that close cooperation between the different stakeholders and a harmonisation of their goals – even if their drivers aren't identical – can help achieve high ambitions. Therefore, it is important to consider the potential synergies between the drivers that the different stakeholders have at the initiation of the planning process. For example, in a neighbourhood refurbishment process, it is possible that the most important driver for the municipality has a social focus: to improve aesthetic and other qualities living environment. At the same time, an important driver for private developers is to increase their profit margins. While these two are significantly different, they can be translated into a common goal: to improve the quality and reputation of the neighbourhood.

In one of the cRRescendo pilot projects (Horst et al., 2014), the main driver was social sustainability of the neighbourhood, and they viewed "physical and ecological" sustainability as preconditions for the achievement of a socially

sustainable neighbourhood. Therefore, their goals included high physical and environmental quality of the development. This further reaffirms the point made above: it is possible to arrive at similar goals even if the drivers in the different projects or between different stakeholders are significantly different.

The number of focus areas and specific goals that are in focus is an important consideration in visionary development processes. Norwegian experiences present two possible ways to approach this issue. On the one hand, it is possible to limit the number of focus areas to ensure that each of them receives due attention. This approach builds on the assumption that in broad programs it can be difficult to ensure the quality of implementation, and therefore it suggests the selection of focus areas that are followed through also in the operation stage. The main message is that it is easiest to be pioneering if the attention is limited to few areas. On the other hand, it can also be a solution to select a broad range of goals but then prioritise them. In this case, it is very important that the priorities are agreed upon by the stakeholders in the process, and that they are made clear in all the plans and relevant documents. Setting clear priorities can be useful when it comes to the implementation stage, as it allows for a revision of the goals while keeping in line with the original aims. This can be especially relevant if new information arises during the implementation, showing, for example, previously unexpected conflicts between different goals, unexpected costs, etc.

Finally, it is important to remember that while the selection of relevant goals is important, it is equally necessary to choose quantifiable targets and indicators that can support assessment of the progress made towards fulfilment of those goals. These targets and indicators have to be selected so that they respond to the goals, and also so that they can be measured in practice (Narvestad, 2010). Certain types of goals and targets are difficult to reach because they are too dependent on other systems (e.g. transport goals are dependent on the overall transport and traffic situation in town). It is also important that the targets set are sufficiently ambitious so that they don’t lose significance by the time the project is realised, as urban development processes often take a long time to implement and they also have a lasting impact on the urban fabric and the building stock. Furthermore, it can be beneficial to consider setting targets that gradually increase throughout the stages of implementation.

Challenges

This report regards a challenge as a perceived obstacle that hinders an achievement from the point of view of a stakeholder. Challenges are therefore understood in relation to a perceived objective. As discussed in the Background chapter, this report takes as a starting point the following classification of challenges and barriers in relation to the implementation of smart energy communities: technical, financial, social, environmental/health, as well as political/institutional. This classification largely overlaps with the classification used in the report about common challenges and barriers created under the FP7 funded

ZenN project (Karlsson et al., 2013), but replaces the organisational/legal category with political/institutional.

It is important to point out that a categorisation of the challenges is primarily of importance for sense-making when designing within complexity (Krippendorff, 1989) and therefore the categories are not absolute. Instead, they are suggested as a way to put issues in a perspective that can aid discussion on how we can move to a community scale of smart energy planning. In most cases, a variety of challenges and barriers overlap and result in conflicts that are not always possible to resolve through addressing only one aspect (Langlois-Bertrand et al. 2015). This is reflected in the description provided below – some of the conflicts may appear multiple times and be described from different angles.

Technical challenges: Technology seems to currently be described as a dividing element within integrative planning approaches. According to the reviewed cases, there is a disconnect between the development of innovative technologies and their implementation. Based on the experiences reviewed, there is a need for new competences among building and renewable energy professionals, in order to overcome these limitations and ensure high quality implementation.

In the case of retrofitting processes, it is important to remember the limitations imposed by the existing structure (Karlsson et al. 2013, Hoarst et al. 2014). This is even more emphasised in culturally and historically significant buildings, where there can be a conflict between heritage rules and new technical solutions.

For the ZVB case, this is not relevant as it is a new development where only new dwellings will be regarded, and in the Furuset case, these issues were not raised by any of the participants. Instead, participants in Bergen raised the issue of whether technical requirements for buildings are moving too fast thus not allowing enough time for the necessary monitoring and evaluation of experiences of living in buildings. Particularly of interest to participants was monitoring of end-user experience, technical monitoring of air quality and aesthetics/atmosphere. In the ZVB case, private sector participants also raised the need for increased capacity building in the building sector, in order to ensure the understanding of fast changing technical requirements. By capacity building was meant the need for carpenters and other house builders to receive more training on the purpose of new technical standards. Particularly regarding the well-being for the end-users of passive houses, which building companies said was questioned by carpenters.

Financial challenges: While technology and technical requirements are advancing, financial challenges seem to be a larger challenge in the Norwegian context. The projects reviewed in the review chapter list budget issues as a challenge to achieve intended objectives. The payback period for the investor is a commonly highlighted indicator. Internationally, this period is regarded as long (15-30 years) (Karlsson et al., 2013). This results in a situation where end-users are not willing to pay the high initial investment cost as residents do not stay long enough in one residency. Also, regulations often limit landlords' ability to increase the rent if new energy technologies need to be financed. The participants suggest that the motivational

cause resulting in the low investment will in Norway may be due to the specific energy situation in Norway. Contextually, there is little or no return on investment because of the low energy price and high labour cost in Norway. Zero emission building or renovation requires expert knowledge on the construction site, which results in high costs. At the same time, the reduction in energy use (and thereby expenses) does not justify these, especially with Norway's current energy prices.

Another financial challenge relevant in Europe is related to unequal distribution of costs and benefits, again especially in the case of renovation (Karlsson et al., 2013; Horst et al, 2014). Costs are typically born by the owner, while the reduction in energy use typically benefits the residents. This challenge is highly dependent on the ownership structure, i.e. whether or not residents are the owners as well.

Service-related costs can also cause conflicts, for example if the municipality are not providing the operation of the indoor and outdoor public areas in the neighbourhood, but do not reduce the operation fees that residents have to pay to the municipality, or if the reduction does not cover all the fees (Narvestad, 2010). This means extra costs for the residents, as they have to privately organise the operation and also pay the municipality, which makes residents dissatisfied.

Health-related challenge: The ZenN report mentions the risk of increased moisture due to airtightness of passive housed, together with a perception that energy efficient buildings are uncomfortable. This aspect was mentioned by interview participants in both PI-SEC cases, even though other studies do not give support for this.

Political/institutional challenges: Political/institutional challenges (Reddy, 2013) are in energy efficiency literature regarded as a separate section that is impacting achievement of environmental goals. These challenges include:

> *Power distribution between (private and public) stakeholders*: One of the commonly cited political/institutional challenges centres on the power distribution between public and private stakeholders in negotiation processes. The necessity to connect to district heating is a typical conflict in low-energy projects, due to the limited amount of heating required by energy-efficient buildings (Narvestad, 2010). From the developers' point of view, this makes the investment cost of district heating connections irrational. This example illustrates the difficulty of the private and public system working together: one is based on legal logics and the other on market logic. When developers themselves take the initiative to surpass standards, they expect something in return. This creates a situation where the parties do not feel comfortable and perceive the situation as a conflict, as it is outside of the realm of their usual way of working. The conflict centring on the perceived imbalance of power between developers and municipalities is also mentioned (Hoarst et al. 2014). However, resolving this conflict is not a straightforward matter. Narvestad (2010) points out that granting exemptions or creating otherwise favourable circumstances might disrupt competition. If certain areas have specific environmental demands

for development, while others don't, this can influence investment targets. Therefore, it should be carefully considered whether this type of solution is beneficial in the specific situation, and the reasons for the decision should be provided.

- *A mismatch between influence and responsibility:* The reports reviewed also cite the difficulty is that the planning departments experience when attempting to bind developers to demands higher than the existing building standard (Narvestad, 2010). Municipalities feel that for successful implementation, it is important to ensure that the demands are in place early in the process and are followed all the way through the planning and implementation phases. This challenge is closely related to the above described challenge caused by the difference between expectations and the negotiation style of public and private stakeholders.

- *Lack of policy backing:* A more clear-cut political challenge is cited by the FP7 ZenN report: the lack of established policies, regulations, standards for low energy/high performance buildings. This means that, based on European experiences, there is a lack of understanding in the legislation of the meaning of low energy. In Norway, this is coupled with a poor demand from the side of the market, leading to unambitious energy targets.

Social/cultural challenges: There are different challenges that are related to social and cultural issues in the realm of energy efficient neighbourhood projects. Some of these are related to other, above cited categories, such as technical or financial issues, as can be seen from the examples:

- *Knowledge-related challenges*: A challenge mentioned in all of the reviewed projects is the level of knowledge about energy efficient solutions and energy use among users as well as professionals involved in the projects. In addition, there is often insufficient knowledge-sharing between the different stakeholders, and there is a need for building competences among the professionals working on energy efficient building projects. Recommended solutions include environmental/energy education, communication and other training activities.

- *In relation to end-users:* According to the ZenN review of energy efficient refurbishment projects, there is a general lack of knowledge on the effect of end user behaviour on energy and emission reductions, as well as a lack of knowledge and interest among residents about energy efficiency. Also, it is important to consider the operation stage of buildings and systems. The operation stage is more challenging to regulate through legally binding documents, especially in terms of user behaviour.

- Further, literature suggests that residents' will and ability to use the building and infrastructure in the designated way is lacking. There are examples of residents installing cooling equipment in well insulated developments with large south facing windows (Narvestad, 2010). However, if individual

residents initiate private action, this does not enable the operator to come up with a common solution for the whole area. If the apartments are privately owned, there is no way to legally bind residents to conform to reduced energy use and discourage private installations of, e.g., energy-demanding cooling solutions. A suggested possible solution is to identify this problem early and come up with proposals for common solutions before the apartments are sold.

- *Cultural/social challenges related to financial issues:* A cultural challenge specific to Norway is that there is a preference for do-it-yourself approaches while Smart Energy solutions will require handing off technically advanced energy projects to external parties (Karlsson et al., 2013). This factor is tied to the financial challenges, as labour costs are high and people often wish to be able to modify their own residencies.

- According to the review of Norwegian projects from the late 1990's (Narvestad, 2010), apartment owners didn't consider the environmental question as a relevant factor when buying apartments. If areas were popular because of their localisation and architectural qualities, they were marketed as high quality residences, with the buyers having above-average income. This meant that the owners who were willing and able to pay the higher price may not be concerned with the savings resulting from reduced energy use. To address this problem, Narvestad (2010) recommends that residents get detailed information about their role in fulfilling the environmental goals, to make them more concerned about the consequences of their behaviour; it could also be beneficial to bind residents to energy targets with legal tools. While environmental awareness and concern among residents could have changed in the last decades, it is an aspect that should not be forgotten.

Case study: Zero Village Bergen

The Zero Village Bergen project, consisting of approximately 720 dwellings (80 000m^2) is expected to include innovative zero emission buildings with roof-mounted solar cells, local thermal energy supply and a first-of-its-kind parking garage built from wooden materials. Details can be found on http://zerovillage.no/om-prosjektet/losninger/

In the plan, there is also room for local retail and other local services. The residential houses are planned to be between three and four storeys tall. The development is located near the Sandsli/Kokstad area which has the highest concentration of industry in Bergen (cca. 15.000 workplaces), combined with a very low number of residential buildings.

Background

ZVB is located at Ådland, about 16 kilometres south from Bergen centrum and about 750 metres south from Blomsterdalen centrum. The area is currently classified as a nature- and recreation area. It is delineated by an existing residential area to the north, by a forest to the east, Vågsbøpollen lake to the south and a road to the west. It is currently mostly greenfield, but some smaller individual buildings already exist. The area has high values according to the cultural landscape assessment, with part of the area having the highest, “A” value, and the rest of the area having a “B” value. While there is a significant distance to the city centre, there is a lightrail station 1,5 kilometres to the north. About 3 kilometres to the west lies Flesland Airport, the main airport servicing Bergen.

ZVB

Zero Village Bergen (ZVB) ligger på Ådland, ca 16 km utenfor Bergen. ZVB skal ha ca 720 boliger og kan dermed blir en av Norges største nullutslipp prosjektet.

Den viktigste faktoren for valg av eiendom for ZVB prosjektet har ifølge utbyggerne vært maksimal utnytting av solenergi samt muligheten til å bygge et høyt antall boliger på samme tomt. Videre har plasseringen av den valgte eiendommen blitt en av de mest sentrale utfordringene for planlegging. Andre fordeler for valg av område har vært størrelse, lokalisering i forhold til mange arbeidsplasser samt eksisterende infrastruktur.

Intervju av deltakere har resultert i funn av ulike systemgrenser (=boundaries). Disse systemgrensene viser hvordan hver deltaker relaterer seg til utarbeiding av smartenergi-samfunn (SEC) innen forskjellige dimensjoner av bærekraft.

Deltakere beskriver en rekke verktøy som de mener har relevans for utarbeidelsen av SEC: det som fremheves mest er plan og bygningsloven, og teknisk forskrift. Av andre verktøy som aktørene ønsker seg inkluderes for eksempel verktøy eller modeller for å påvirke bærekraftig transport, gjennom visualisering, bedre modeller for å bygge alternative energi-scenarioer og design av bygg for bærekraftig adferd (sustainable behaviour).

The solar potential on the site is high, also in the winter time. It is outside of the concession zone for district heating.

Energy and greenhouse gas emissions have been central in the planning of this residential area. The greenhouse gas emission ambition levels are based on the Norwegian ZEB definitions (Sartori et al., 2011) as illustrated in Figure 8. The plan is to have a set of different ambitions based on the scale and the time of construction (Risholt et al., 2014). Accordingly, the neighbourhood is to have an overall ambition level of ZEB-O, meaning that it should be carbon-neutral in the operation stage. The buildings built in the first stage of implementation having the lowest ambition level of ZEB-O÷EQ, so the locally generated renewable energy doesn't have to compensate for the energy use related to the equipment not integrated in the individual apartments (with additional restrictions regarding the embodied emissions from the building materials). Then, within two years, the ambition level for the next stage of implementation should improve to ZEB-OM, when the embodied emissions in the building materials also have to be considered; and the last stage, within 4 years, should have the highest ambition level of ZEB-COM – compensating for construction, building materials and operation, including equipment installed in the apartments.

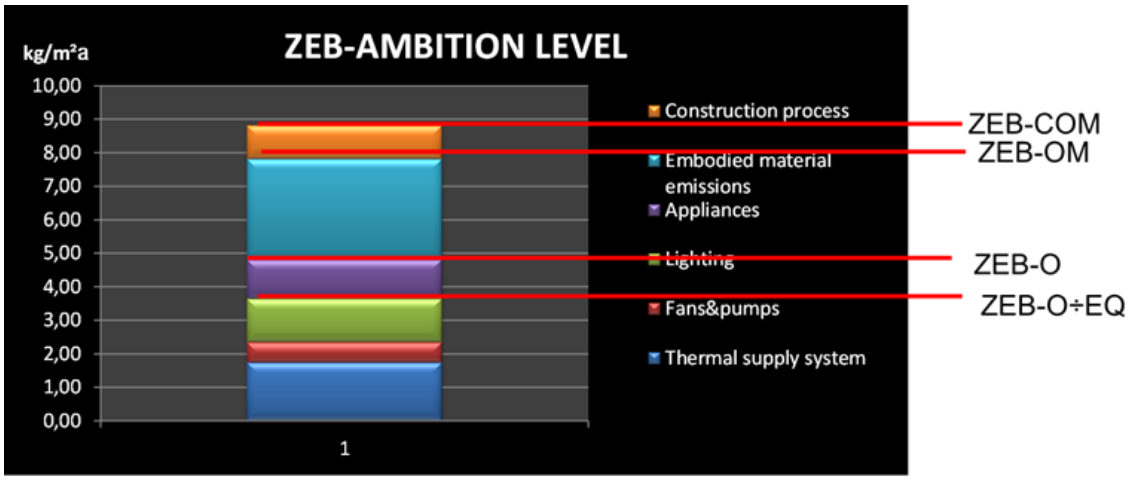

Figure 8: ZEB ambition levels (Dokka et al., 2013)

The process of developing a plan for this neighbourhood started in 2009. In 2011, ByBo, the private developer leading the process, together with Norconsult, started the regulation process for the area. In the same year, ByBo entered a partnership with the FME ZEB Centre, and Zero Village Bergen (then referred to as Ådland) became one of the FME ZEB pilot building projects. In 2013, a new projection for noise was made due to the planned expansion of Flesland Airport, resulting in a need for revision in the plans. Part of the original building site was now in a "red zone" according to the noise levels, where residential buildings cannot be built. The rest of the site falls into a "yellow zone", where buildings can be placed based on individual evaluation of the fulfilment of indoor and outdoor requirements about noise levels. At this point, new consultants have been involved, including Snøhetta as architectural consultant, and SINTEF ICT and Multiconsult for the development

of tools to solve the airport noise challenge. As a result of the difficulties relating to the noise level, “shadow mapping”, an innovative tool to calculate and visualize how buildings can work as sound challenges while ensuring sufficient solar irradiation has been developed by SINTEF ICT and Snøhetta for the purpose of this project.

The relevant Kommunedelplan as well as the plan for the specific area has been under revision due to a number of objections relating to various aspects of the development from the regional governor dating from 2010 and 2014, as well as restraints set by the Ministry of Environment. These objections and restraints will be detailed later in this chapter.

Role and status of the energy system in the planning process

The Ådland property was favorable to make it economically and technically viable to consider a local heating system and to have good/optimal solar irradiation for energy/heat production. Solar availability for energy harvesting has been a strong driver and the main factor for the selection of property for the ZVB project. The location of the property is also what has caused the most significant challenges of interest of this case. The following ZEB principles were central (Risholt et al., 2014)in the selection of the proposed building site,

- the land should be unoccupied, in order to avoid demolition and related transportation of materials,
- unregulated (no prior zoning plan), to make sure that environmental and energy-related concerns can be considered from the early stages of the zoning regulation process;
- large enough to be divided into various implementation stages, in order to allow new solutions to be implemented in a sequential building process with incremental learning, as well as to enable certain technological solutions (e.g. local heating system);
- minimize the amount of materials that have to be deposited and moved in and out of the construction area

The evaluation also considered other aspects, such as localisation in relation to public functions, transport and public transport connection, need for residenial units

in the area, consequences on land use, natural resources and outdoor life, as well as stationary energy use in the buildings.

Figure 9: ZVB street level (Snöhetta)

According to the 2010 evaluation, the benefits of developing a residential neighbourhood on the appointed property are that they may contribute to the densification strategy being considered for the area south of “Flyplassvegen”, it’s proximity to large workplaces and proximity to established infrastucture. Further, the project expects to contribute to establishment of walking and cycling paths in the area and to enhance the nearby “lokalsenter”. Further, the biking distance to lightrail station is intended to fit with the lightrail strategy of the municipality, even though there is no direct bikepath planned. Further, the following advantages were listed:

- The property lies along a public transport path (kollektivtrase) where publc transport may be reachable
- There is a need for more residential units due to population growth in the area
- Establishing a residential neighbourhood will improve the balance between workplaces and residences in Southern Bergen
- The development will create a clear deliniation between built-up areas and the LNF-area
- The development has small impact on agricultural land

- The residential development will have small to medium negative impact on nature, landuse, cultural environment and landscape.

Figure 10: Aerial photo Ådland (Snølhetta, (ZVB, 2016))

The possible challenges were identified at the time as follows and are also repeated in the objections by the Regional Governor (Fylkesmann) with additional remarks:

- Ådland is not a priority area for development in the KPA
- It is not close to the centre, and is ot a prioritised densification zone
- It will increase the city's "footprint"
- The area lies within a zone of air traffic noise higher than the allowed Db limit and the noise may be health damaging.
- It is defined as LNF zone. The area use in the zoning plan has to be changed
- Using this property means that parts of the recreational zones will be repurposed for buildings
- The public transport connection is outside of walking distance
- The development can lead to increased need for transit parking
- The development will increase the demands on the existing infrastructure.

During the planning process, the combination of high ambitions in relation to emissions and energy use combined with site-specific challenges initiated a number of innovative solutions. These involve, as mentioned above, a shadow-mapping tool in order to resolve the conflict between sound shadowing and solar irradiation, as well as a wooden parking garage in order to significantly reduce embodied emissions from building materials.

Perceived boundary conditions, drivers, and impact in ZVB

This chapter is concerned with insights relevant for the determination of system boundaries, drivers and challenges. The objective of the greater project PI-SEC is to develop useful instruments that can improve the synergy between these for the purpose of more effective and meaningful implementation.

Therefore, in order to understand the planning process of ZVB holistically and how the different stakeholders contribute to the identified agendas, a diagram has been made which places each stakeholder in relation to drivers and stakeholders' perspective of system (sustainability) boundaries. Figure 11: Drivers, boundaries and stakeholder influence in Furuset from interviewsFigure 11**Error! Reference source not found.** on the following page shows a map of the relationship between drivers, boundary conditions, and perceived influence of stakeholders by participants.
As for the Furuset case, the presented discussion of the figure will begin at the core of this figure before it moves outwards. Drivers will be discussed under the subheadings of each boundary.

Boundary 1: Local energy system

Local, regional and international energy supply are viewed as interconnected by BZV project, making the boundaries of the 'energy system' fragmented. The local energy system is still perceived of local supply and demand for renewable energy resources, yet the capacity needed to create a sustainable energy scenario is seen as a more holistic issue. Researchers as well as utility providers believe that expertise and product/service supply must be an exchange of what is available in Bergen and from other areas internationally, for the local energy system to achieve ideal performance and add to current knowledge on energy supply research. The drivers in this process, as described by researchers and utility company, are knowledge based and they express how the learning aspect of the process has been, is, and will be valuable to them on many levels. A private transport strategy based on renewable energy and car pools has been designed as a reply to the objections on the location of the planned dwellings. Therefore, transport companies, utility companies and researchers are the main influencers of the local energy system. Main identified drivers for the mentioned stakeholders are:

- *Capacity building*
- *Knowledge creation*

The main drivers of the stakeholders that are involved in efforts made within the local energy system category, were *Capacity building* and *Knowledge creation/learning*. City planners alongside utility mentioned and reveal a strong need for learning more about how to integrate local energy systems into the planning processes. Capacity building is therefore a main driver for wanting to be a part of the ZVB flagship project. On one side, they want to build capacities within the company/municipality and on the other hand they want to create learning for the industrial development and research future of the region.

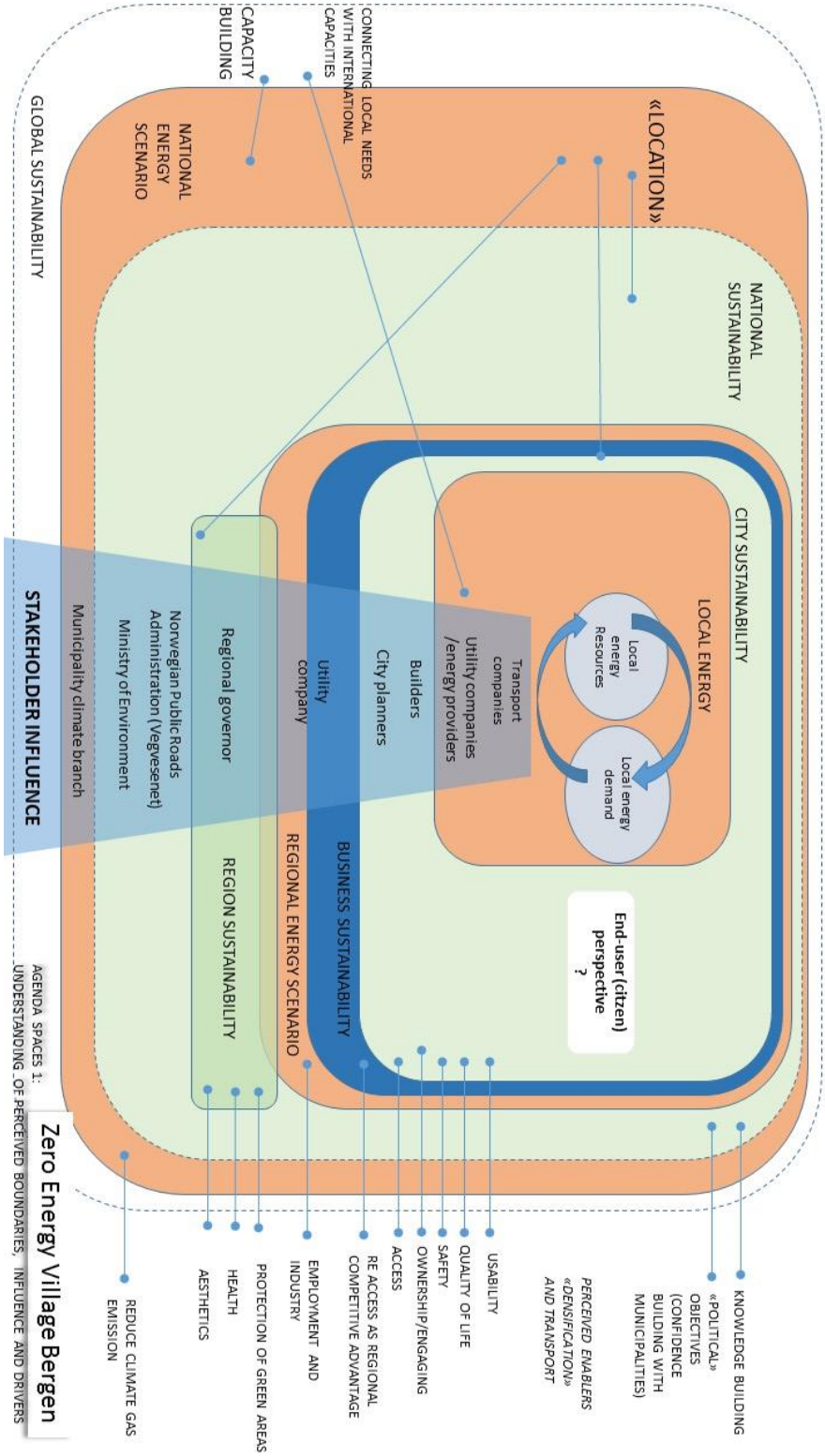

Figure 11: Drivers, boundaries and stakeholder influence in Furuset from interviews

Boundary 2: City sustainability
City planners in Bergen perceive their main task to create good living environments for the citizens in Bergen. Within this they include safety and accessibility, and they see a potential in designing buildings so that they invite inhabitants to behave sustainably. One participant used personal bike use as an example:

" I want the possibility to wash my bike at the ground floor of my building, that would make it easier for me to use a bike"

This is only one example of how the participants perceived mobility as the most relevant and visible link between energy use and citizens. All participants explained that they wanted transport planning to be an integrated part of Smart Energy Communities (SECs), but beyond this, they did not see how energy supply and use was relevant to their everyday work as city planners. Builders do also perceive their goals to be an integrated part of city sustainability, hoping for a green energy future for all Bergen's inhabitants. Identified drivers include:

- *Quality of life ("gode bomiljø")*
- *Safety*
- *Ownership / engaging city*
- *Accessibility*
- *Usability*

The abovementioned drivers are overlapping in the sense that they are often mentioned within a similar context and as one leading to another. City planners perceive that quality of life for the citizens of Bergen is their main 'holistic' driver and that achieving this depends on safety, creating a city that people can engage with, where they have access to what they need. That citizens have easy access to sustainable transport such as bikes, as mentioned in the quote about personal bike use, also depends on the usability of buildings and user-aspects of infrastructure.

Boundary 3: Business sustainability
Utility companies connect the ZVB project to the future competitive advantage that West-Norway as a region has due to the high availability of energy resources. They therefore see business opportunities in connecting the two, making the business sustainability a space between regional sustainability and the local energy system. Further, they see it as a strategic and important decision that they chose between simply delivering energy to buildings, or whether they should also be involved in the business models and actual design of Smart energy systems within the buildings. They see a dialogue with city politicians and planners as a necessity to achieve sustainable business models that will benefit stakeholders on a regional level.
The main driver of this perceived system boundary is therefore

- *Competitive advantage* (for the region, for the builders and for the involved utility companies). In Bergen, the utility company sees energy as the competitive advantage of the region and an important one to keep and use to their benefit. This includes keeping knowledge and good business model understanding that reaches from understanding of supply to end-user of smart energy systems inside buildings.

Boundary 4: Regional Energy sustainability

The regional governor (Fylkesmannen) perceive themselves to be the main governor for regional sustainability and to ensure good living environments regionally. As explained in boundary 3, the utility company also look at regional *energy* sustainability regionally, they are not driven by health and green area protection in the same manner as the regional governor is. The Regional Governor has been a strong influence on the planning process, as he has objected to the municipal plan (kommunedelplan KDP) twice due to the location of the ZVB. The fundamental objection is linked to the location of the project outside the planned densification area of Bergen. According to the two participants interviewed at Fylkesmannen the noise level of the airport has resulted first-off in a health damaging situation for inhabitants. They particularly emphasize the harmful situation for children that will live in the area. Further, they perceive that the following statement from the Ministry of Environment in 2013 has resulted both in a poor design of how the buildings are positioned and in a little user-friendly activity area between the buildings that either has to be closed off by glass or not have satisfactory amounts of sunshine. Further, the Fylkesmann participants perceive the area as aesthetically damaging to the overall planning of the region and object to the intervention on nature and recreational areas.

Drivers:

- *Aesthetics*
- *Health*
- *Protection of green areas*

The two representatives for the Regional Governor (Fylkesmann, RG) value health as a central element in their mandate to enforce national environmental directives. They emphasize healthy environments for children in particular, and argue that this concern is the main reason for the current objection to the zoning plan. That the noise levels expected from the Bergen Airport may be damaging to people living in the area is seen as a major issue that makes it out of the question to pass the proposal.

Further, Aesthetics is an underlying value that the participants from the office of the Regional Governor hold high, and that is related to the current city densification policy.

> *"If you fly over Norway, it looks as if someone has been throwing Smart houses from the air"*

The quote above also reflects the view on researchers as a stakeholder group and suggests the importance of taking into account the relevance of our role as researchers on ZEBs. This distrust to the relevance of ZEBs in relation to city planning and environmental concerns was expressed several times.

In the Regional Governor's perspective, the chosen property must remain a nature and recreational area, and ZVB is too far from current and planned public transport infrastructure, according to him. Beyond this, the planning process of ZVB is perceived as closed and they perceive that the private interests or research stakeholders have never listened to the priorities of the city planners nor the Regional Governor.

Further, the RG interprets the statement from the Ministry of Environment to support his view, given that the requirements set by the Ministry of Environment is not possible, according to him, to fulfil within the current location.

Finally, it must be noted what can be seen from the Figure 11, that the RG is the only stakeholder that argues deeply rooted in the idea of regional sustainability, overlapping some with the Bergen utility company.

Boundary 5: National sustainability

The National Roads Administration Vegvesenet have been influential on the ZVB planning through the highway and public transport plans for the city area. Vegvesenet is driven by national policies that wish to make it more difficult for citizens to access the highway than it is to reach public transport (kollektivknutepunkt). The debate concerning the distance between road infrastructure, public transport and Ådland where the project is planned to be built, has centred on whether the inhabitants of ZVB will need to reach work places in Bergen or in the more nearby Kokstad/Sandsli area. City planners believe that most of the inhabitants will live in Bergen and therefore will end up depending on private car transport. On the other hand, the ZVB partners argue that the Kokstad area will be more relevant and that they can add transport options such as shuttle buses as well as a reduced amount of parking space in order to motivate inhabitants to use public transport.

A key point of conflict in the statement from the Ministry of Environment lies in the fact that the public transport access point (kollektivknutepunkt) must be in place before the dwellings can be implemented; something that delays the project even further. There is also less incentives to speed up the building of public transport access points as long as there are few dwellings in the area, and this conflict is one of the catch 22's in the project. Vegvesenet (the National Road Administration) and the Ministry of Environment have therefore been key stakeholders which are perceived to have and have had a strong influence on the final outcome and further planning process. The main driving factor of relevance for National sustainability and Vegvesenet is:

- *Location*

Vegvesenet's role in the zoning plan is relevant due to its decision power when it comes to where the future highway will be expanded in relation to the planned public transport route. Vegvesenet has decided not to expand the highway from the airport to the city center and not to imrove access for private cars to the highway through the area surrounding ZVB. This is because they want to motivate citizens to choose public over private transport. Location is therefore the significant driver and one that they have in common with most stakeholders influencing the zoning plan.

Boundary 6: Global sustainability

The participant researchers in Bergen as well as the utility company are focused for international relevance of the chosen energy resources. They see the future energy scenario as one where energy resource extraction and use is a global issue and where we must exchange expertise between nations and between regions. Some regions in Norway has less availability of renewable energy while others have a lot. Also, it is regarded as a weakness that the ZVB project chose a location mostly based on the solar energy access; while experts on other areas such as thermal or ground water experts were only consulted after the location has been chosen. This shows the relevance of connecting local, regional and also international skills when planning SECs with the consequent drivers:

- *Capacity building*
- Knowledge/learning

Researchers involved in the ZVB project have capacity building and learning as drivers in common with the utility company. However, the researchers suggest that capacity building and skill exchange globally is vital for the creation of strong and high performing local energy systems. Researchers in Bergen believe that Norwegian industry must build on existing knowledge and skills and improve upon these (such as oil and gas extraction and drilling), and apply these globally. At the same time, they believe that we must bring in international expertise on the energy resource sectors that we are not familiar with traditionally (such as wind farms and geothermal resources and storage). This exchange of knowledge and understating how to integrate international expertise in planning of SECs was mentioned several times. The planning process of ZVB was criticized for focusing too much on solar energy when choosing property, and the need for knowing more about ground water status and geothermal potential and so forth was seen as lacking.

Tools

Participants involved in ZVB have listed their perceived tools that are illustrated in Figure 12. The blue frames represent the tools they perceive they can influence SEC planning through, while the grey frames represent tools that they believe could support their decision making or improve the planning process for SECs in another way.

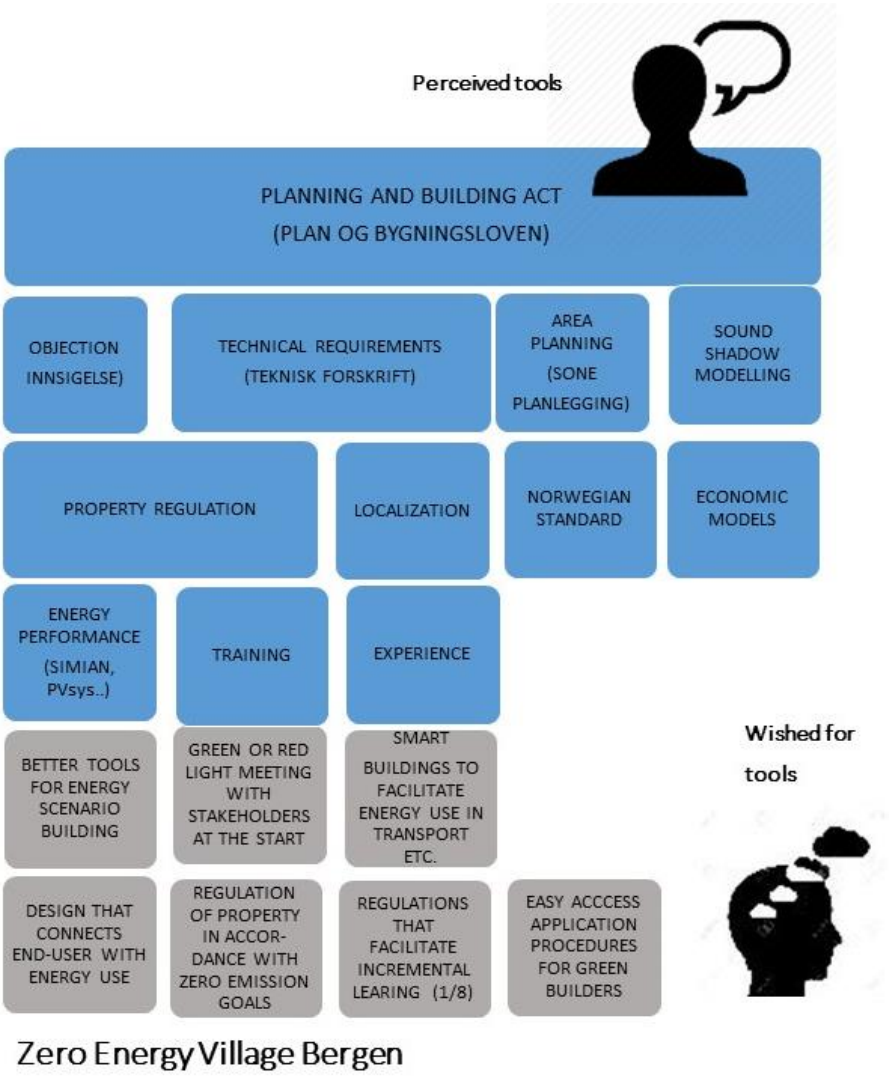

Figure 12: Perceived tools(blue) and wished-for tools (grey) ZVB

Perceived tools

- *Planning and building act* is mentioned by all participants as the 'go-to' tool(s). Included in the statements regarding this act, *Property* and property regulation was most often mentioned as the influential tool from public sector stakeholders. The opinion among participants was split on the topic on to which extent public sector should dictate the use of property. Participants working with climate gas emission reduction

supported a high extent of regulation, while participants working with zoning maps were less inclined to support strict regulation. They perceived more regulation to imply longer and more difficult planning processes. City planners typically said that most tools they need are available, yet it differs to which extent they are used:

"All the necessary regulations are there the problem is that we don't apply them!" (City planner, Bergen)

- *Documentation and official statements, including:*
  - KDP
  - KDP planbestemmelser
  - KDP Fagnotat
  - Vurdering KDP miljødepartement

- *Zoning/Area planning:* Zoning and 'reguleringsplan' was referred to as the most useful yet also the most challenge-producing tool. City planners explained how they had to use detailed indications of land use when signifying a preference of location, while this again made the potential of changing the zoning map challenging. The seemed to think that the way they used the zoning tool influenced the understanding other stakeholders had of the process and priorities. This was, according to city planners, something that should be used with caution.

Gap

The discussion on zoning indicated that it is a tool that may be perceived differently by non-city-planners and that there may be a need for better tools to collaborate on zoning.

- *Localization* was seen as the most relevant factor for the overall environmental impact of the project, and placing entities in geographic relation to each other was hence regarded the most important tool when interviewing public sector stakeholders. For example, city planners mentioned microclimate as something that the planners can affect through building placement, and that is directly impacting energy.

- *Objection (Innsigelse)* has been a central tool in the ZVB process. The objection of the Regional governor to implement ZVB were similar to the mentioned challenges by Norconsult made already in 2010. These challenges are repeated in the statement by the Ministry of Environment

in 2013. According to participants, this objection is used to protect regional sustainability in accordance with national environmental laws. Objection is therefore a result of not resolving the core conflict about the location of the ZVB project.

- *National political priorities* were by some participants seen as highly influential particularly to the start-up of the project. Regional governor and city planners partly feel that knowledge-based city planning is overrun by national priorities that 'promised' the implementation of the project without consideration of their objections regarding chosen property.

- *Market prediction:* Utility companies are applying market prediction tools extensively and base their involvement in projects on a cost/benefit analysis. They do, however, believe that there is a need for tools that can do a cost/benefit analysis (*Cost calculation: infrastructure, maintenance, running costs, etc.)* on larger, integrated projects in urban area planning.

- *Experience:* private sector builders explain that they think one of their most important assets is their in-house experience.

- *Training:* ensuring that carpenters understand the reasoning behind energy saving housing and the building processes was mentioned as a challenge and a key to create ZEBs and SECs. Sometimes carpenters have their own experience that does not agree with newer technical requirements (teknisk forskrift) and there is a current opinion among many that the technical requirements are changing too fast for them to understand the benefits in terms of good indoor quality and quality of life.

Wished-for tools

- *Integrated tools for city planning* and energy design: there is a wish among participants for flexible tools that allows for stakeholders to think of the larger system, including transport. In general, participants in Bergen describe larger system boundaries when wishing for new tools, than in Oslo where they are more strictly focused on local energy. (This may have to do with the fact that Furuset is an existing area with clearer boundaries. The selection of good property is a central challenge in Bergen where the municipality also own few properties.) The Norwegian Water Resources and Energy Directorate (NVE) is mentioned as a possible stakeholder that could demand larger area alternative cost/need calculations from project owners.
  Yet participants also reflect upon the issue of decision making structure if tools are going to embrace an increased span of interests; this would, according to participants, demand more political or stronger decision making power at a higher level.

- *"Quality of life" tool*: Participants from all sectors ask for tools that could help them balance different aspects of smart energy communities; from health aspects in relation to energy saving and material use, and their impact on quality of life/user experience

- *Design Tools for sustainable (transport) behaviour*: City planners want policies that demand that properties bike access to properties and bike user friendly buildings

  "places where people can wash, fix, place their bikes…. Areas to put the wagon that they pull their kids in… nobody can take their bikes into their apartment shower to wash… haha" (city planning participant)

- *Improved kick-off of projects*: Tools that could have prevented the root cause of the challenges regarding planning process in ZVB included a mandatory start-up meeting between all stakeholders. This could be a green/yellow/red light meeting where the foundations of the project could be discussed and a draft of objections could be included. (note; this 'oppstartsmøte' is already on its way into common regulation processes)

- *Binding property regulation* independently of owner: planners wish to have legally binding to property so that if one property is promised to be a zero emission project, it will stay that way if they approve it in the city plans

- *Planning tools that make it easier to implement 'large' projects*: in Bergen, the 800 planned dwellings of ZVB was referred to as something that is larger than what they have much experience with. The utility company also express wishes for lager area electric load calculations that can support decision making.

- Incremental learning tools: the current zoning tools are not appropriate for pilot projects such as ZEB that intend to have a learn-as-you-go purpose. The project wants to decide future steps taking into account the learning from each innovative building step, while the intention of the planning and building act is to draft purpose of land use prior to its implementation:

  "How do we plan everything now, if we are supposed to build and learn continuously in a project?"

Reflections regarding tools (from the participants' side): The use of flexible / combination tools require a more defined overarching strategy ('if *we* really want this…)

Case study: Furuset

Furuset is an existing neighbourhood: a satellite town built in the 1970s. The aim of the urban revitalization project is to change this satellite town into vibrant downtown area, emphasising environmental, physical and social aspects. The more overall aim is to act as a role model for other sustainable urban development projects in Oslo and elsewhere in Norway. However, Oslo municipality had started focusing on the area earlier, in 2007, as a part of "Groruddalssatsingen", an initiative based on cooperation between city and state, focusing on neighbourhood-level improvements in this part of Oslo. Further work was done through the planning process initiated in 2009 by the Planning and Building Services at the City of Oslo.

The area is chosen as a case for the FutureBuilt Programme that runs between 2010 and 2020 together with 49 other cases. Furuset is unique as a FutureBuilt project, as it is the first project where they work on a neighbourhood scale. The project has a steering committee with representatives from various municipal departments.

Furuset

Furuset er et eksisterende nabolag, en drabantby bygget på 70-talet. I dag har Furuset omtrent 9000 borgere og 1500 arbeidsplasser. Målet med revitaliseringsprosjektet er å gjøre Furuset til et aktiv bysenter. Mer overordnet er ett av målene for Furuset å fungere som rollemodell for andre bærekraftige byutviklingsprosjekter i Oslo og i resten av Norge.

Den viktigste årsaken til at Furuset er valgt som FutureBuilt (www.FutureBuilt.no) prosjekt er at Furuset er det første prosjektet som fokuserer på nabolagsnivå i stedet for å fokusere på bærekraft i individuelle bygg.

Ved å intervjue involverte deltakere har sju forskjellige systemgrenser blitt generert som forklarer de involvertes innflytelsesgrad; den sier noe om hvordan de beskriver og oppfatter sin rolle. Hovedbidragene fra disse gruppene er relatert til for eksempel å skissere det lokale energi systemet, til å være forkjemper for innbyggerperspektiv, eller lokal, regional og nasjonal bærekraft.

Deltakerne beskriver også en rekke verktøy som, etter deres mening, er relevante for å påvirke disse systemgrensene. De ønsker seg for eksempel flere incentiver for å investere og implementere nye energiløsninger, i tillegg til ulike visuelle eller finans-baserte scenario-verktøy. Mange av verktøyene som deltakerne ønsker seg er knyttet til lokalt innbygger-engasjement og verktøy som kan øke forståelse av energibruk, energiproduksjon og utslipp i sammenheng.

Figure 13: Site visit in Furuset, August 2016

The site is located in Oslo, to the east from Oslo centre, towards Lillestrøm. It is the eastern part of Groruddalen, with about 9000 inhabitants. The refurbishment area incorporates about 3800 residential units and 1500 workplaces. About 90 percent of residential units are in apartment blocks built in the 1970's, owned by 12 housing cooperatives, with 2 of the blocks being condominiums. The rest of the neighbourhood consists of smaller, older houses located in the part called "old Furuset". The local real-estate prices are relatively low in comparison to the rest of Oslo. The neighbourhood has many indoor and outdoor recreational and green areas and is in close proximity to Østmarka, and the residential buildings and outdoor areas have been upgraded in recent years. There is also a lively culture life, but it is not very visible. There are good public transport connections, including two metro stops and different bus lines. On the other hand, there is little car traffic crossing in the area.

At the time of the writing, a number of projects have already been implemented. Early in the process, the Municipality of Oslo used a participatory approach in order to find out the needs of the residents, especially local women and youth. One of the wishes was to get meeting places outside. The planning of the Verdensparken started in 2008, and the last phase of the park was realized in 2016. The park has a variety of features, including fruit trees, new lighting and vegetation, water fountain, sculpture and climbing wall.

Residential projects are also under way. At Ulsholtveien 31, the apartments are mainly aimed for young people. Construction work started in February 2016 and altogether 36 rental apartments are currently under construction. Furuhuset, the existing building will be turned into nine apartments and a common area. The most important measures for Utholsveien are the use of passive house standard for the new dwellings, geothermal energy, solar cells, charging station for electric vehicles (eventually car-sharing), heat-recovery from wastewater (Byggemesteren 2016). The project is done as public-private partnership. Central in the planning was also covering a segment of the E6 highway with the intention to reduce noise and increase the potential building area with 700 dwellings in addition to the added aesthetic value (see Figure 14).

Figure 14: Illustration of Furuset with highway bridge ('lokk')

Besides public spaces and residential units, there are also efforts to improve the services and social infrastructure in the area, including schools. Granstangen secondary school was the first FutureBuilt building project. It is a passive house and it has been built as public-private partnership.

The significance of process organisation

In the case of Furuset it is interesting to consider the role of FutureBuilt in enabling and stirring the planning process. The approach of organising the project under the umbrella of FutureBuilt is expected to ensure outstanding quality in the neighbourhood redevelopment. Their proactive work with the stakeholders is expected to support the success of the implementation.

Role and status of energy system in the planning process

In relation to the energy system in the neighbourhood, the following ambitions are stated:

- A well-functioning, water-based distribution network for energy that covers the heat and cooling needs of the area. A good operation and maintenance model has been developed.
- The energy standard in all new buildings shall be higher than current legal requirements.
- 40% of the total energy use in the area is to be covered by renewable energy sources.

- Densification is a factor of high relevance in relation to energy use and sustainability in the Oslo region. In a transformation perspective, the Furuset project has the possibility of transforming a characteristic residency area into an area with improved living quality through the achievement of a sustainable urban ecosystem.

Figure 15: Illustration (a-lab) of Trygve Lies plass

Perceived boundary conditions, drivers, and impact at Furuset

In order to understand the planning process of Furuset and how the different stakeholders contribute to the goals of each stakeholder, a diagram has been made which places each stakeholder in relation to drivers and stakeholders' perspective of system (sustainability) boundaries. It is important to specify that these boundaries represent the participants' input and not facts regarding the actual process.

Figure 16 shows a map of the relationship between drivers, boundary conditions, and perceived influence of stakeholders as pictured by the interviewees in the Furuset project. The discussion of the figure will begin at its core and move outwards. Drivers will be discussed under the subheadings of the boundaries.

Boundary 1 Local energy system

The map shows the local energy system in the orange rectangle at the core of the figure, as it is described by participants. Relevant to their account for what has been relevant when making decisions for the design of the local energy system, is which stakeholders are already present and have the permit to deliver waste heat, together with the local energy demand. The main influencers of this design consists of the expected beneficial situation of the utility company which makes the municipality aware that there is high amount of waste heat available in Oslo, and local services that have expressed that they have a need for this waste heat. The utility company works as an innovator in the sense of conceptually connecting resources and needs in Oslo. For example, they specify that the waste heat from the local hockey club can be used, while electric buses can run in the area and contribute to the local objective of decreasing traffic.

From the side of the city planners, they do not perceive that they currently have the tools to influence the energy design and find it difficult to understand how local energy use can affect larger perspective climate gas emission reduction.

Boundary 2: Business sustainability

The second rectangle, in blue, describes the business model design processes that are ongoing to create economic sustainability for the energy systems planned at Furuset. The program for reduction of climate gas in Oslo, Klimakutt 2020, as well as utility companies and builders see that in order for the local energy system to make sense and be attractive, good business models must be developed. At the core of designing good business models to link social expectations with sustainable energy use, the utility company talks fondly of *incentives*.

The following driving factors were repeatedly mentioned by the stakeholders focusing on issues within this system boundary:

- *Achieve first movers:* the stakeholders who influence the energy design (the utility company, Klimakutt, service providers and transport) believe that incentives to influence first movers is essential for a good continued process to achieve the sustainability objectives of Furuset.
- *Incentives* were highlighted as essential factors for them to realize their ideas; the presence of transport companies that wish to make use of renewable energy was mentioned as one type of incentive. This shows how the presence of certain types of stakeholders in a SEC can be relevant for the sustainability and the implementation of a project.

Boundary 3: City sustainability

FutureBuilt, together with the City Planners, influence how the Furuset project relates to overarching city sustainability goals. Drivers that were emphasized by the city planners were:

- Quality of life - to improve or maintain quality of life for all citizens
- Avoiding gentrification of an area
- 'Lift' the perception of the area ('områdeløft')
- Increase ownership feeling (also of energy)
- Protection of green areas
- Aesthetics
- Learning/knowledge building for city planning processes
- Creating a (visible and accessible) link between local energy use and global emissions

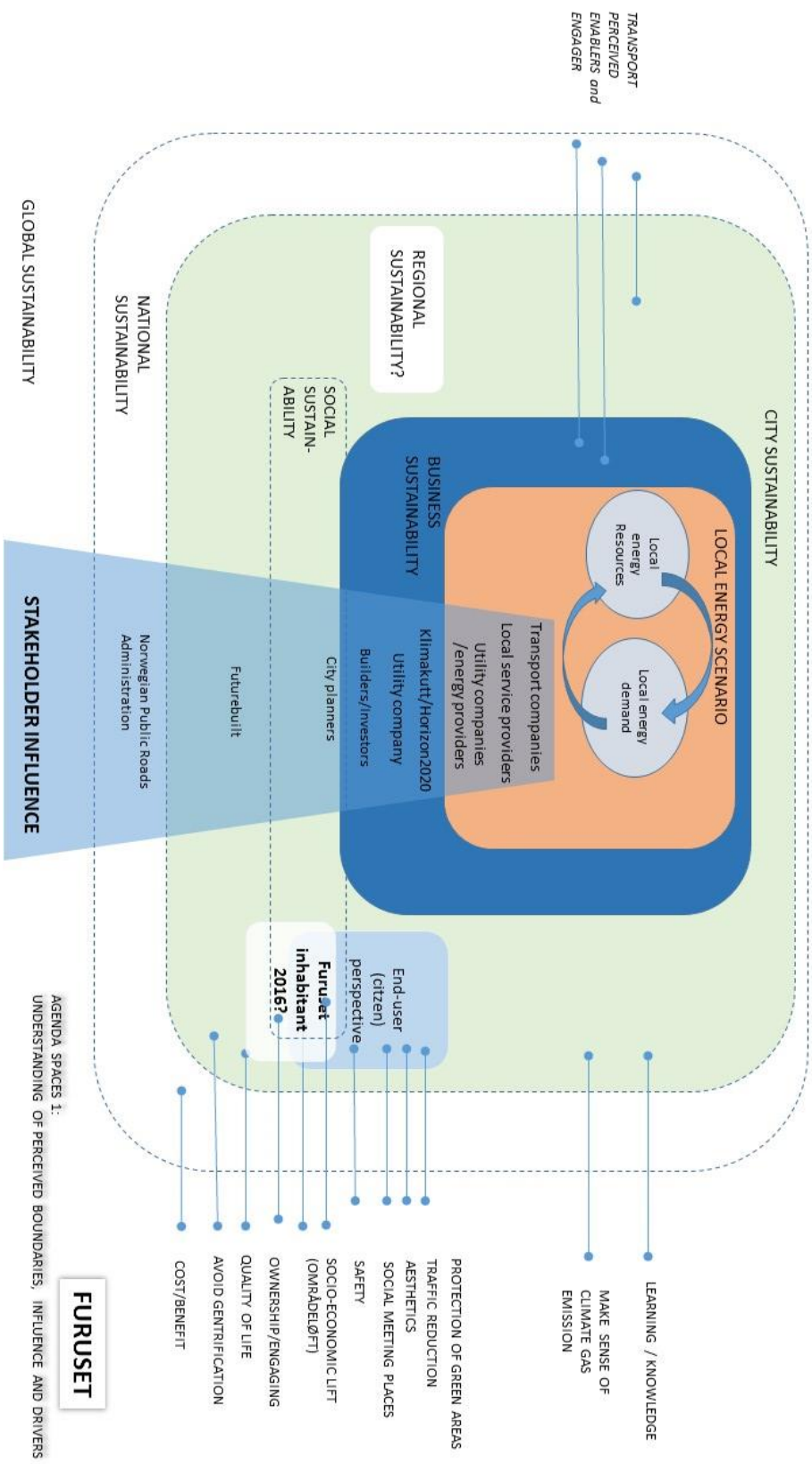

Figure 16: Drivers, boundaries and stakeholder influence in Furuset from interviews

Boundary 4: Citizen perspective

The citizen perspective is placed within the city sustainability view and is an image influenced mainly by the city planners. Participatory approaches were applied extensively in order to include the local voices of Furuset, to describe their wishes for the area and to ensure that the plans for the area take these into account. A pre study of Bjørbekk and Lindheim was completed in 2008. This pre study was followed up by a participatory study created by Landskapsfabrikken, directed by Bydel Alna/områdeløftet. This created the further basis for planning and work to finance the Verdensparken. The work was completed in collaboration with Friluftsetaten in Oslo Municipality. End-user involvement had a central part in this work. Different user groups and in particular youth, participated in accordance with the model 'participatory learning and action' (PLA). The extended goal of the

participation was to create a continuous space for dialogue with inhabitants in Furuset and to include their perspectives in the planning. The citizens described safety feeling and access to social spaces as main drivers.

The identified drivers of these stakeholders included:

- Safety
- Local meeting places
- Limit traffic
- These drivers were based on end-user insights and hence these are the only drivers within the two cases that are based not on the participants own or their own institutions policies but on knowledge about the end-users.

Gap

Boundary 5: Furuset Citizen 2016

The insights from the participatory approaches undertaken at the beginning of the planning process are tied to social aspects of living at Furuset and to the objective of creating the Verdensparken. Later stages of the process were delayed due to local resistance to the creation of a road to connect two parts of the Furuset area, showing that energy related issues such as transport had not been targeted in the participatory learning and action approach. This exemplifies that there is a knowledge gap that needs to be filled.
There is a need to know 'who is the Furuset Citizen of 2016 and beyond' and this knowledge needs to include insights that also show relevance to how these can be bridged with the sustainable *energy* scenarios that are currently being designed. A broader stakeholder participatory process could attempt to fill this gap, while city planners perceive that *engaging* the local community in the understanding of energy use and local benefit through *visual* tools is a way to include these aspects.

Gap

Boundary 6: Regional Sustainability

In comparison with the ZVB case, the perceived system boundaries in the Furuset case leave out a discourse on the larger regional sustainability perspectives. The energy system design mostly takes into account the local, short-distance, energy supply such as waste heat. In contrast to the Bergen Zero Energy Village project, this means that a number of energy sources have not been explored. This may have to do with the fact that the ZVB project had a high involvement of different researchers in addition to the fact that the stakeholder agenda of the utility company in Bergen and Oslo differ. It may also be that the perception of system boundaries is influenced by the problem definers (FutureBuilt + the municipality) who describe a clear and limited definition of system boundary compared to the ZVB case.

Boundary 7: National sustainability

The zoning plan for the Furuset area originally included an intention to build a tunnel over the highway E6, referred to as a 'lid over E6'. This was an ambitious plan that would reduce noise levels, increase the aesthetic values of the area as well as adding space for more dwellings. However, The Norwegian Public Roads Administration (Vegvesenet) did not agree with these plans due to the cost/benefit ratio being too high. Vegvesenet is hence the main influencing stakeholder of this boundary in this project, with their driver being identified as a cost/benefit in relation to building the highway tunnel. Main driving factors can hence be described as:

- Cost/benefit
- Safety – if the NPRA was going to prioritize a highway tunnel, there would have to be important safety concerns included in the argumentation

Tools

Figure 17 describes the tools that the participants perceive that they have, in blue, above the tools that they express a need to have in order to fulfill their objectives:

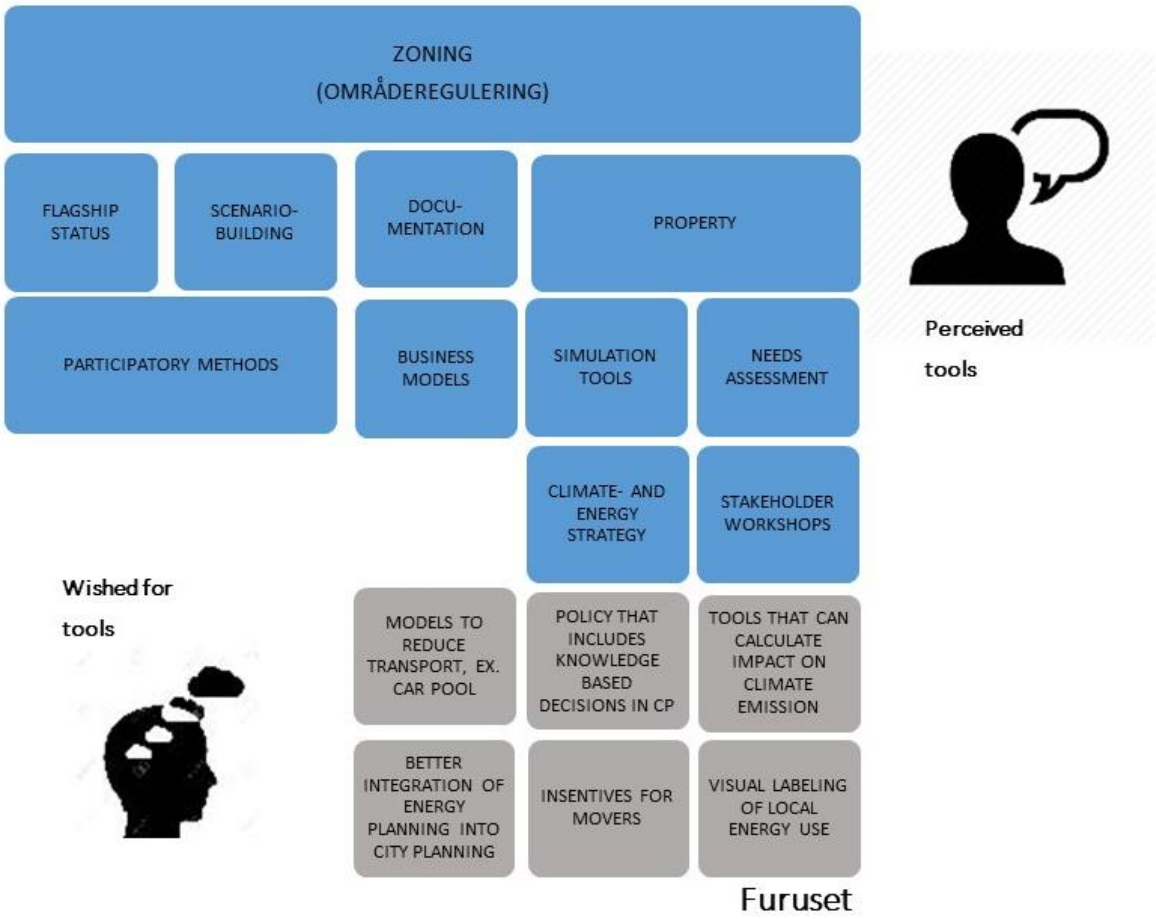

Figure 17: Perceived (blue) and wished-for (grey) tools, Furuset project

Perceived tools

The relevant existing tools mentioned in the interviews include:

- *Property and Property regulation;* participants explain that the fact that Oslo Municipality owns property in the Furuset area and other areas give them an advantage when planning SECs. This supports the findings in ZVB yet the support for strictly regulating property was lower in Bergen. In the Furuset case, participants use examples from Swedish pilot projects when explaining how the

political regulation should be stronger in Norway and how they wish they had more influence on building processes and power to implement environmentally visionary ideas.

- *Incentives:* Participants explain that the process would benefit from having more incentives to invest and implement innovative energy solutions and buildings in the Furuset area. They mention Enova and the Municipality as possible stakeholders that could implement such incentives and mainly refer to financial risk reduction when talking about incentives.

- *Scenario building:* Participants, particularly from private sector, explain that they use scenario building tools to understand how the future energy systems should look like, and this is particularly applied when designing business models. The architectural competitions arranged before the creation of Verdensparken, and the ideas created through the participatory processes at Furuset, can also be regarded as scenario building tools.

- *Documentation:* the documentation of decision foundation and background information about the area's citizens and needs is a significant strength for the project and also for the strong personal involvement of the many stakeholders. However, the documentation of possibilities also creates expectations which increases the stress participants encounter when wanting to fulfil all these expectations.

- *The new Climate and energy strategy* of Oslo is mentioned as a tool that can help stakeholders collaborate better in order to reach climate goals through step-by-step target setting.

- *Simulation tools:* Participants from the utility company and Klimakutt explain that they use simulation tools for the purpose of understanding demand and supply scenarios for energy systems for Furuset. *Open source python was mentioned as used for modelling* long-term, economy-wide greenhouse gas mitigation scenarios.

- *Stakeholder workshops:* stakeholder workshops had been arranged, yet it was challenging to do this as a continuous process.

- *Flagship status:* together with the Climate and Energy strategy, the FutureBuilt affiliation was perceived as an important tool because it made it easier to implement visionary solutions in what was perceived by some stakeholders as a challenged area for development.

Wished-for tools

A significant amount of wished-for tools at Furuset are tools that can be linked to the 'engaging city' aspect of SMART cities (Eger, 2000):

- *Labelling energy use:* Participants thought that tools that could make local energy use visible could help bridge the 'sense-making' gap between (Weick et al., 2005) local energy solutions, local benefit and global climate change issues. By sense-making here is meant the difficulty to find meaningful approaches where an approach will make real impact on the said objective. A much referred to example was the use of waste heat from the Furuset Hockey club's ice rink with the quote:
  'There is so much extra heat here in Furuset that even the crows are warm and comfy'

- *Simulation tools:* simulation tools are particularly mentioned as something that could make it easier to achieve an integrated and well-functioning local energy design. This was both mentioned as of relevance for the creation of business models for renewable energy utilization for residential buildings, and as a decision support tool through simulation of demand/supply balance of energy in Furuset.

Gap

Business component: A significant gap was mentioned when talking about local and renewable energy systems with Furuset stakeholders. The need for business models that could help implement smart energy solutions were asked for. In this case, the low-*income* and car dependent population of Furuset was questioned by some participants as they perceived them as a 'challenging' customer group that made it seem risky for investors to contribute to innovative energy designs.

- *Bilfangst/carpooling* were mentioned as examples of tools that could bridge the transportation challenges of Furuset citizens

- *More agreement based and follow up of how private property owners hold agreements regarding visionary environmental projects* were mentioned as something that could be used more extensively, however the challenge was that this is time consuming and therefore delays already lengthy implementation processes further.

- *There seem to be a trend that the zoning plan (områdereguleringen) and participatory approaches are seen as unnecessary and time consuming and thus many are afraid that there will be a situation where one moves directly from planning program (planprogram) to building.*

Gap

Improved Knowledge Based tools:
City planners wish for clear policies that allow for knowledge based planning «so that this is not perceived as a time thief».

This gap is a result of the notion that city planning as a process is challenged by two sides; on the one side, they are expected to create smart and knowledge-based urban communities, while on the other side they are under high political pressure to increase the amount of housing within the borders of Oslo.

This gap is further linked to the need for tools that can bridge findings from the traditional participatory planning tools with current and more complex needs of Furuset – including energy and mobility.

Discussion

The difficulty of understanding how and why to integrate urban energy design into conventional city planning processes stands out as the challenge expressed by participants in the two reviewed projects. The findings show how the understanding of energy, energy design and the relationship between energy consumption and greenhouse gas emissions is interpreted in terms of what the participants understand that they can influence or what is part of their daily work. The following sections discuss similarities and differences between the two cases, and provide an overview of tools that have been used in similar projects for solving these issues. Finally, we suggest some areas where new tool development may be necessary.

Comparison of the two projects: similarities and differences

One of the topics that seems central to planners in both cases is *transport*: participants express that they prefer that transport remains within the system boundary when planning Smart Energy Communities. This might be explained by the way they perceive the sustainability concerns they have direct influence on. What they perceive that they have most influence over (see tools comparison in Figure 18) is where housing, work and services are located in relation to each other (*localization* and *densification)* and property regulation in accordance with the planning and

Diskusjon

Dette kapittelet sammenligner planleggingsverktøy fra ZVB og Furuset og gir et lite innblikk i hvilke verktøy som er anbefalt brukt ifra litteraturstudiet i begynnelsen av rapporten. Til slutt er noen gjenværende behov nevnt.

Funnene fra begge case viser at det kan være utfordrende å forstå hvorfor og hvordan man kan integrere energiplanlegging med konvensjonelle byplanprosesser. I begge case er det også et klart ønske om å integrere samferdsel ved planlegging av smarte energisamfunn.

Eksisterende studier på emnet viser at pådriverne i prosjektet påvirker prosessen. I ZVB er pådriverne private aktører og det uttrykkes et ønske om bedre kommunikasjon av forholdet mellom politisk vilje og praksis. I Furuset har offentlig sektor hatt en mer sentral rolle. Her bør man se på verktøy som kan påvirke økt involvering av private interesser. Prosjektets og visjonenes skala, samt oppfatning av sluttbrukeren er sentrale elementer når planleggingsinstrument skal settes sammen.. ZVB har for eksempel et sterkere fokus på byggnivå mens Furuset har fokus på samfunnsnivå Et sterkt ønske fra interessenter i begge prosjekter er visualiseringsverktøy som kan bygge bro mellom energisparing, bærekraftig energi og livskvalitet blant annet gjennom å engasjere brukere. Dette tror byplanleggere kan bidra til å beholde troen på en kunnskapsbasert byplanlegging.

building act. Another possible factor is their daily work routine and their field of knowledge. Transport and urban planning has a more direct relation traditionally than energy and urban planning.

In the Furuset case, transport companies have worked as an enabler and a pre-condition for the utility company to take part in the project. In the ZVB case, the question of sustainable localization/transportation is listed as a main objection to the development and finding a satisfactory solution for transport is a pre-condition for implementing the project.

There is an impression that the utility companies are influential on the final energy systems design yet these specify that they are simply presenting solutions for solving energy needs based on available resources. As the municipalities do not have necessary capacity to coordinate the R&D process regarding energy, this may add to the biased impression of the utility companies' agenda also due to the few utility companies involved in the long project planning processes.

Furthermore, participants in both projects are looking for tools that can enforce sense-making in the interaction between citizens and SEC design. However, there is a difference between how the two projects understand and approach the end-user. In the ZVB case, participants are more interested in the usability aspect *within* buildings, and believe that this is an important aspect when trying to connect ZEBs with SEC through transport and smart solutions. In the Furuset case, participants are thinking more on community level, presenting a need for tools that can engage citizens at a broader or more collectively envisioned community level. This may suggest that the two projects have different views on the prospective inhabitants; one being more individualist (ZVB) and the other more collective (Furuset). The following quotes exemplify this difference:

> *"for example, Mrs. Hansen can sit in her apartment and put into her TV that she wants to go to the city at this time, and the TV will transfer that info so that an electric car will be ready for her at that time" (Participant at the ZVB project)*

> *"It would be nice, if there was a visual feedback at the hockey stadium, that could tell the citizens of Furuset that this energy is used for something that benefits the community" (Participant at the Furuset project)*

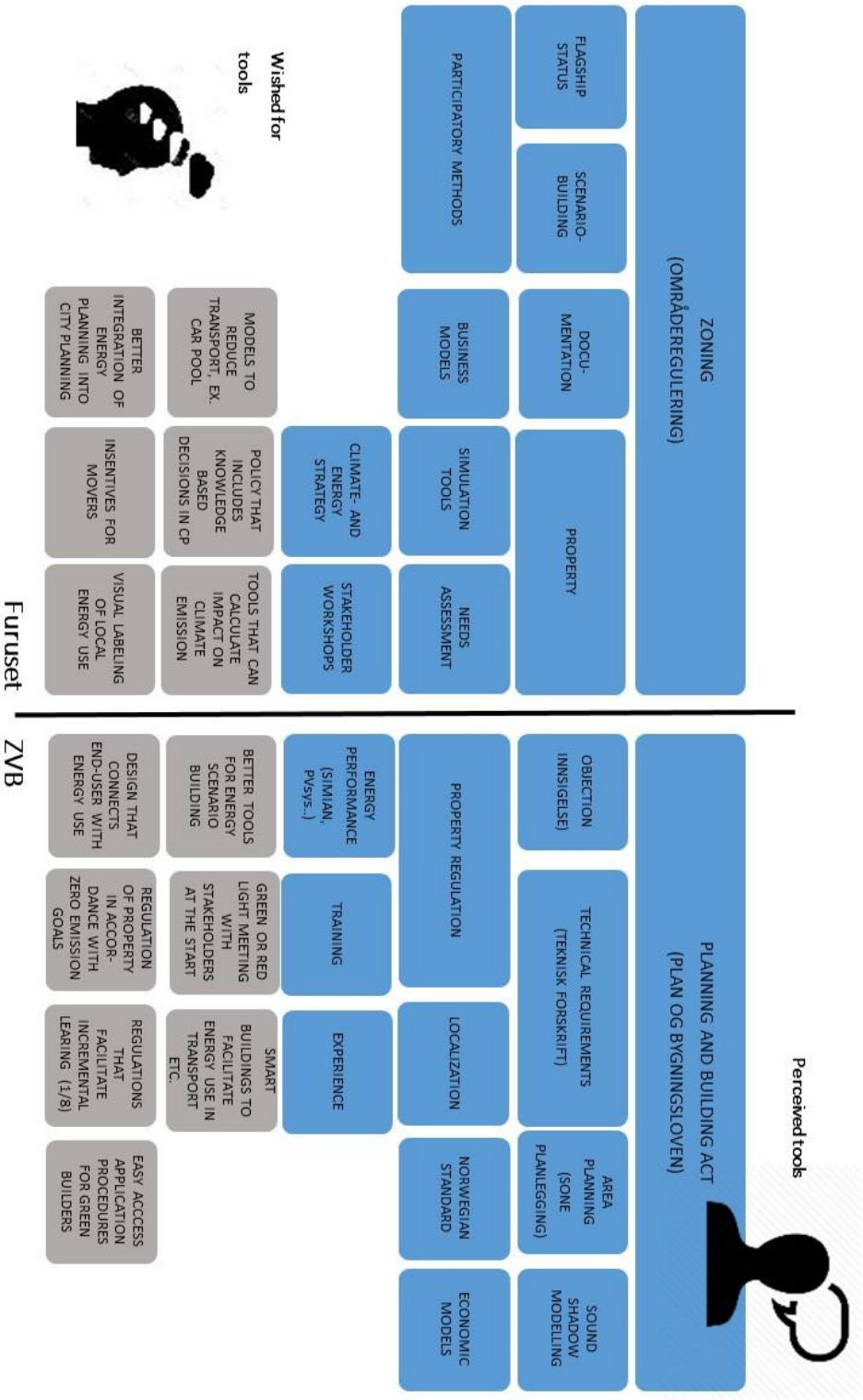

Figure 18: Tools comparison between Furuset and ZVB

A possible explanation to this difference could stem from the difference between the initiation and central stakeholder in the two projects. In Furuset, the process was initiated by public bodies, with a primary focus on the improvement of the overall quality of the neighbourhood, and energy use is seen as one of the aspects of this general, community-scale improvement. On the other hand, ZVB has been initiated by a private developer, in cooperation with energy-focused consultants and research institutes, traditionally more concerned with building-related issues.

Despite the difference in community vs. individual citizen, the quotes show that participants in both projects want the planning instrument(s) to include certain *visualization tools* that could help bridge the sense-making gap between emission reduction, sustainable energy use, and urban living quality.

A noticeable common factor therefore becomes the need for tools that can ensure *engaging* urban communities, most commonly described as visual feedback and visual scenario building. In Bergen, the property selected as the site of the development is privately owned, and city planners wish that they had stronger regulation power over property regarding energy and emissions. Oslo Municipality, on the other hand, perceive that the fact that they own property for the purpose of building pilot buildings and urban space is a major advantage in this regard.

Regarding the planning process, both projects are waiting to be implementation-ready. Private sector talks about the need for *first-movers* and therefore ask for more effective *incentives.* In ZVB, private sector participants ask for *political* first-movers, while in the Furuset case, participants want more financial incentives in order to influence *private* sector first-movers, again underlining the differences stemming from the difference between the central stakeholders in the two projects. This shows that both cases are looking for tools that can interrupt ‘business as usual’ and make sure the planning processes towards innovative and knowledge-creating projects can be implemented to a satisfactory degree.

The influence of the central stakeholders on the planning and design processes are also important to discuss. Since the political backing has been stronger in the Furuset case while private sector and research stakeholders have been more prominent in the ZVB case, the plans and designs have evolved differently. City planners in the Furuset project have applied traditional participatory development tools to understand the social expectations for the urban design. Hence, the Furuset development is founded on a strong knowledge base and corresponding expectations from inhabitants. However, there is now an identified gap between the information gathered during this process and the information needed for the successful planning and implementation of a Smart Energy Community. In comparison, in the ZVB project, the energy performance of the neighbourhood has been central from the early stages, resulting in feasibility studies and preliminary recommendations for energy supply systems and specific energy efficiency solutions. Additionally, the objections and requirements put on the ZVB from the Regional Governor and the Ministry of Environment has inspired a cross-sectoral research effort to create a holistic energy design which again have led to innovations such as tools for sound shadow modelling. This means that the ZVB in

theory has advanced more on the energy design. Even though participants say that the process has been too lengthy, the results may indicate that the troublesome power relationship between Regional Governor, Municipality, Developer, Research stakeholders and Ministry of Environment actually works in the favor of smarter energy communities.

Overview of needs, tools and approaches

In the following sections, we provide an overview of the needs identified in the two cases, as well as some examples of relevant tools and approaches that can be found in the literature. However, we do not provide any specific recommendations in this report, as that is planned to be delivered as part of Task 2.2 (see the chapter "Further work" at the end of this report).

One planner expressed in Bergen, 'we have all the tools but the problem is that we don't use them'. There is a general awareness among participants that tools for many of their challenges exist, yet it is difficult for each stakeholder to understand the relevance of these tools for reaching their day-to-day objectives.

Gaps based on the analysis of the cases are strongly linked to knowledge and learning and decision support: Related to energy systems, city planners find it difficult to understand the relationship between the larger energy grid vs. micro energy systems, and utility companies will need help to provide useful knowledge about this to the city planners. There is hence a strong general need for instruments or tools that can assist city planners in adding alternative energy scenarios into their city planning.

In this context, it is important to understand Instruments as something that the participants find useful for the implementation of their own work/contribution.

Tools to make green energy use visible to citizens but also to understand the impact of decisions on emission reduction are needed.

Knowledge/sense-making tools that participants include in their wished-for-tools are assistance to define what is 'good' and 'bad' energy and how to reduce in a holistic view. They also ask for improved planning regulations that help avoid certain obstacles:

- Green/yellow/red light informal meetings between municipalities and builders before project start – in a functional way. The current planning process and start up meeting is perceived as too rigid.
- Help municipalities decide when it is beneficial to give detailed requirements and at which level
- Deal with the expectations and impact of participatory approaches
- Alternative scenario-building tools: cross-cutting 'prediction' tools that include distances, access, transport, use (as life cycle assessment)
- How to plan for learning step by step: tools that can make the municipalities feel they are 'in control' while the other stakeholders also fulfil their needs and goals
- The diverging understandings about energy in the planning processes among the different stakeholders

Many of the tools that participants expressed to be unavailable, are available in international case review and literature: for example case reviews on incentives, GIS based Energy Atlas (Ramakumar et al., 1995), SynCity Integrated toolkit for urban energy design (Keirstead et al., 2010) Sustainable design methods (Lilley, 2009, Lockton et al., 2008, Mckenzie-Mohr, 2000, Wever et al., 2008) (Pettersen and Boks, 2008)

A brief introduction of relevant tools and approaches from literature

The tools that have been encountered during the desk studies can be divided into Planning Tools, Knowledge Exchange tools, Monitoring and Evaluation tools, Business Model Tools and Incentives.

Planning tools: Experiences from the studied Norwegian cases show that including demands in legally binding documents throughout the process enable them to be fulfilled; especially in cases where the demands are tied to the design of the building mass, and are coupled with good result indicators and measurements (e.g. type of energy use, share of eco-certified building materials). Clear communication, realistic ambition level, consideration of extra costs (Narvestad, 2010) are important considerations in this respect. In order to ensure that the requirements are fulfilled, they should be included in documents that are valid in the various phases of the project. Below is an overview of the various planning tools mentioned by Narvestad (2010), and their use and effect in the planning process:

Reguleringsplan (RP)	Legally binding	Very static/rigid	Environmental demands in the reguleringsplanbestemmelser seems very beneficial
Miljøoppfølgings-program (MOP) and Kommuneplan (KP)	Not legally binding	More dynamic/flexible	Useful for illustrating relevant practical solutions
	The content can be tied to sales contracts and development agreements – binding under civil law		The development process of the plan can give a sense of ownership and obligation – very beneficial
			They might also ensure economic feasibility of the project as they initiate calculations
			Where the area is privately owned, it is possible to encourage the owner/developer to create MOP or KP.
Kommunedelplan (KDP)	Not certain whether it is legal to use it for environmental demands – RP was also used		
Handlingsplan (HP)	Not legally binding		Staring point includes agreement between private and public actors. 'Political anchor' ensured through political agreement
			Mostly formulated as a vision document, with few measurable quantitative demands

Figure 19: Use of tools in development processes (based on Narvestad, 2010)

As the various planning tools have different benefits and legal implications, Narvestad (2010) points out the potential benefits of combining them in the negotiation and planning process.

Note that while the ambitions stated in MOPs are not legally binding, it is possible to include them in sales or lease contracts, and create a bond under civil law. This has also been used in one of the cRRescendo cases (Horst et al., 2014).

Knowledge exchange tools: Participants in both of the studied cases often mention the need for decision support tools, which can help them visualize and make sense of complex scenarios. The review provided many examples of such tools.

The Columbuskwartier Tool: Sustainability compass is one example of how a Sustainability Matrix, divided into 3 Ps (People, Planet, Profit) can be used for development of the district and then in the assessment of tenders for the southern part of the district. This tool has been tailored to different contexts, which shows its transferability. For example, it was further developed by Saxion College into the Sustainability compass, a context-relevant, validated tool. In the Netherlands this

tool further evolved into a web-based tool and is widely used in the Netherlands (Horst et al., 2014). Urban planners in Denmark also use similar tools during the planning and negotiation of development processes and concrete projects.

Within the topic of knowledge exchange tools comes the question of more applicable participatory tools. The city of Almere (Horst et al., 2014) chooses to include citizens in sustainable behaviour through creative activities involving children in getting to know the renewable and efficient attributes of the neighbourhood. There is still a question of whether this type of sustainable awareness raising among citizens will solve the challenges related to end-users within the two cases. City planners in Bergen and Oslo seem to rather look for *combined* instruments that couple different income levels and social aspects with integrated urban design, visual energy feedback and business models to decrease financial risk.

The Milton Keynes Tool (Horst et al., 2014) includes a framework plan, with a spatial framework into which construction sites could be fit in later. This plan suggests that it is important to aim to first create s cohesive vision for the whole neighbourhood and next, use the market to bring in more creativity to the specific construction sites, working within the predefined framework. The tool has served as a valuable basis for achieving the sustainability goals.

Regarding a need for better exchange of knowledge between stakeholders, the RAMSES project (Kallaos et al., 2015) provides a tool for self-diagnosis of the continuity of urban services. The tool might be useful for workshop with stakeholders. It is a tabletop exercise, using a scenario of a real or hypothetical event. Stakeholders can interact in the exercise, and build the model themselves by discussing responses, approaches and reactions to certain events. It can also highlight differences/similarities in management. Co-creation between project developer and municipality also enables two-way learning/capacity building in innovative projects and increases the chances of reaching targets. Similar approaches are used in urban planning under the umbrella of city or policy gaming (for some examples, see Play the City[12], or Games for Cities[13]).

For communication with (future) inhabitants, where the clear difficulty is that the building projects will be completed before inhabitants are moved in (and therefore the target group is unclear), the experiences from Almere could be useful. The following tools were used:

- Explore Lab: inhabitants can express their wishes and expectations towards architects and builders
- Sustainability Lab: knowledge-transfer to the project and to employees of municipality
- DurzaamAlmere.nl: sustainability shop in the centre of Almere City as meeting point for citizens, municipality and local businesses

[12] http://www.playthecity.nl/
[13] http://gamesforcities.com/

- Providing instructions to residents on how to use the systems
- A toolbox for residents who want to build their own houses, including a voucher for free professional advice. This latter part could be useful for addressing the social challenge identified in Norway in the ZenN project (Karlsson et al., 2013), where people want to feel control over their own building/living space and wish to modify most elements themselves.

Creating synergies through business models and incentives: Business models are often mentioned as possible enablers or mitigating factors for challenges that participants mention such as high investment cost, delayed implementation and few involved stakeholders. There are several business model simulation tools, yet it is difficult to identify directly transferable tools that could fit the Norwegian context. Examples are however emerging in Nordic countries on how to finance and lease solar technologies to reduce financial risk. One relevant tool may be the "Company"On" Model (Horst et al., 2014). This is a model where company-owned solar panels are placed on buildings. The user does not have to invest initially, instead pays a small annual fee for use of the sustainable energy source. Similar examples can be found in Finland as well.

As mentioned in the overview of common challenges in the reviewed process, when developers themselves take the initiative to surpass standards, they expect something in return. These incentives do not have to be directly financial. Exemptions from regulations, quick and uncomplicated regulation process, provision of public infrastructure, supporting the sustainability goals, access to public competence and support, etc. can encourage private developers to implement above-standard requirements without legal tools (Narvestad, 2010), and can put public stakeholders in a good position to negotiate. A typical conflict in energy-ambitious development projects is around the requirement for incorporating district heating in the energy system. Granting exemptions from this requirement, and tying it to the achievements of certain energy-efficiency ambitions, can be viewed as an incentive for implementing high energy standards in development projects. Nevertheless, according to the information gathered in the previous decade, municipalities in Norway do not give these exemptions often, and there are questions about whether such exemptions would disrupt competition.

It remains a question whether the public authorities can follow up the fulfilment of environmental ambitions that were not legally binding, as expressed by participants in relation to the Zero Village Bergen case. The challenge is therefore, according to the reviewed cases, to create incentives by providing win-win situations where legal tools cannot be used, and they can also be beneficial in addition to legal tools in order to create a good cooperative environment.

For projects where the ambition is only a bit higher than current practice (building code), a simple contract between the municipality and the builder has been shown helpful in the reviewed projects. High ambition projects are, as the stakeholders interviewed fear, less predictable. Recommendations for such cases include:

- In externally funded projects (e.g. under Horizon 2020), the developer should dispose its own budget. If the ambitions are not met, the partner does not get paid.
- Giving the developers a clear and determining role within the project. This supports the identified need expressed by public stakeholders in both ZVB and Furuset: the need to break down longer perspective visions into understandable goals for each project partner.
- The cooperation level can also be based on the ambition of the project. The higher the ambitions, the stronger need for close cooperation and clear coordination.

Monitoring and evaluation tools: Even though ZVB and Furuset projects are premature for the final decision of what have been suitable tools for monitoring and evaluation, the incremental learning plan of both projects will benefit from testing out some relevant tools. Monitoring and evaluation is closely related to the targets and KPIs, and therefore the PI-SEC Task 1.1 report should be consulted. However, the desk research and stakeholder interviews provided some highlights that are worth mentioning here:

- The CONCERTO and other standards are useful, but the effects of occupant numbers and occupant behaviour are important to consider
- Monitoring combined with intervention on energy behaviour after monitoring results are received can be useful
- Potential instruments: combining technical monitoring (for example energy use) with monitoring of social aspects (for example number of occupants).

Follow-up tools are also provided from social research methods. Milton Keynes lessons (Horst et al., 2014) suggest the use of a local social research partner, independent research and activities, interactivity and the development and application of surveys. This will also be important to extract knowledge about the most significant gaps in the two projects; understanding and identifying the potential end-user and end-user needs. Questions that were asked in the Milton Keynes studies included information about surface area, number of occupants, heating, cooling, water, lighting, electrical appliances, kitchen, renewable energies, invoices etc. Another study analysed the water, gas and electricity consumption of all public buildings. Office building have some differing concerns, where Milton Keynes includes: office layout, office furnishing, thermal comfort, air quality, lighting, acoustic quality, cleanliness and maintenance, general comments. These tools, however, focus on the individual building level and do not reach to the mobility aspect that was emphasized by participants in our study of Furuset and ZVB.

It is also important to further identify relevant initiatives and priorities in relation to housing, construction, energy efficiency and micro energy generation. Resident surveys are also a good way of identifying people's general knowledge and familiarity with technology as a baseline.

Remaining gaps and mismatches

A common finding of the ZVB and Furuset cases is that we need better tools to ensure that goals are reached and to understand how to break down these visions to smaller and more understandable targets.

One problem is that it is not clear who the end-user is in visionary/pilot projects. It is well documented that when end-users are not investigated, assumptions are made about their preferences that may not be true(Skjølsvold and Lindkvist, 2015). For example, in ZVB there is no clear view of who the end-user is/will be as it is a new residential area. On the other hand, in Furuset there is extensive documentation of end-user needs, yet this info is soon outdated, not future focused, and the findings are not integrated into energy planning. There also exists a number of assumptions about who the end-user will be in both cases. When city planners talk about 'good living environments' (gode bomiljø) they often use their own experiences as examples, while private investors make assumptions about end-user behaviour and motivations. It is therefore essential to figure out more accurate or have a discussion on what are meaningful ways to address end-user concerns for both cases.

The stakeholders currently find it difficult to understand how they can integrate energy planning into traditional urban planning instruments. Participants suggest that business models will play a role in making this bridge, as well as visualization of energy use and local energy production, and design for sustainable behaviour. In design for sustainable behaviour they mention both smart-technologies such as the possibility to affect energy use directly through appliances or computer interfaces, as well as the physical design of building space. They want buildings to be designed so that they facilitate sustainable behaviour, particularly transport. This is only one of the indications that participants see mobility/transport as the 'engaging interface' between building and city. As cities grow, project leaders also say that they need help to manage (organize) multiple projects with a high number of stakeholders, while keeping a common objective in terms of emissions. Finally, how to make sense of the relationship between local and fragmented energy systems in a city and larger scale emission reductions is a concern in both cases.

Of course, in order to reach objectives in complex problem situations, the tools themselves do not solve underlying issues because there is a misalignment in the process. Also, there is a general attitude from city planners and regional governors that if private interest 'sits on the fence' until the political landscape changes, they will get their agendas through despite what the city planners do.

> *"At the end of a process, builders and property owners come and sit down on the politicians, and they always end up putting aside all qualified knowledge provided by the city planners"*

Whether or not this is true, these impressions show that there is conflict of interest and power issues that affect the urban planning that are worth taking into account when discussing smart energy city planning.

A shared concern is that Smart Energy planning will only consider each part individually and not work enough on integrating the main priority of ‘good living environments’. A recurring comment is that about passive/energy saving buildings and the wish to expand the definition space of smart living:

> *«Smart solutions must catch the totality of environmental concerns and not only consider how thick the walls are»*

Whether or not this quote reflects reality, it tells us how people invested in their citizen’s quality of life and sustainability at different levels perceive the development within the energy saving/energy producing houses. They perceive it as an issue that they cannot influence and hence irrelevant for their own work. This shows the need for better knowledge sharing and also a stronger focus on integrating ZEBs into SECs. The future process for energy in urban planning has to take this into consideration and create or use tools that can ensure that stakeholders perceive their contribution as useful. If urban planners think that their input is irrelevant for the planning of energy systems, and decide not to work on the integration between energy and physical planning, then there is a danger that smart energy planning will contribute to gentrification because profit will be the most influential driver.

For the purpose of theory and research methodology development, it will also be useful to further reflect upon what is a system and what is a boundary (especially in relation to Smart Energy Communities and the move from building to neighbourhood scale), and to reflect upon how changes in stakeholder composition affects system boundaries and incentives. From the Furuset project, it is also relevant to look into why participatory efforts haven’t reduced local resistance or influenced energy planning. A final unanswered question is whether the labelling of ‘forbildeprosjekt’ is positive or negative for the planning and implementation of a vision. The Furuset project has been an issue for research on impression and reality in urban planning (Andersen et al., 2015) which points out these aspects and supports the relevance of these questions.

Conclusions

In line with the discussed findings of Narvestad (2010), the overarching perception of participants is that there must be more work on aligning drivers into common objectives. Keywords in the participants' input into how this could be achieved are visualization, engagement, location, mobility and scenario building.

Overall, city planners are scared that knowledge basis will be overrun by pressure on faster implementation, the need for more housing and increased densification without significant consideration of sustainability. According to them, there seem to be a trend that area zoning (områdereguleringen) and participatory approaches are seen as unnecessary and time consuming and that many are afraid that there will be a situation where one moves directly from planning program (planprogram) to building.

Participants from all sectors (private, public, research) believe that this concern can be mitigated by more extensive use and easier-access to visualization tools that help make sense of energy planning and will benefit multiple levels of the planning processes. For city planners, this includes a need to understand what is the micro energy system and what is beyond it. There is a very simplistic understanding of what is 'climate friendly' solutions since they don't have the time or background to go into the complexity of this. City planners further perceive that there is an urgent need to connect and engage end-user in the relationship between own behaviours and communities and larger-scale climate effect. Regarding the intuitive wish to understand the link between smart energy community planning and user aspects, the interface between building and end-user behaviour and mobility between home and activity must be explored when developing tools. The system boundaries and available tools are understood as more rigid in the Furuset case than in the ZVB case. Often, participants reckon that the question about smart energy is defined by the distinction between fossil fuel/no fossil fuel or electricity/fossil fuel energy.

A broader issue is that the projects would benefit from better compliance between municipal area plans and national plans and objectives (Vegvesenet, national politicians, Ministry of Environment etc.). Clearer political visions that take urban planning priorities into account could according to private and public sector participants help connect agendas at the beginning of the project and ensure alignment between property selection, infrastructure planning, regional with local objectives etc. Again, there is a perception that appropriate scenario planning tools that can balance energy with other life-quality issues relevant for city planning can assist this need for alignment.

They also see that as cities grow, bureaucracies grow, and knowledge based city planning is increasingly regarded as a delay between plan and implementation. For city planners that are afraid of an unsustainable development of urban areas, particularly of increased social differences, this is emphasized as a priority for tool development. This is a stronger concern in Oslo yet the consequences of Smart

Energy technology introduction on overall social sustainability is also a concern in Bergen.

Moreover, both projects are looking for measures that can connect end-user aspects with smart energy community planning. The solutions they have tried and that they suggest, fit within a design for sustainable behaviour frame. In the Furuset case, there is a need for tools that can connect current and past citizen needs with future energy and urban living scenario plans. The need to connect knowledge from end-user level to technological to large-scale infrastructure planning will require simplification and approaches that are useful in practice. In Bergen, the end-user is not clearly defined and this is an area for improvement(Skjølsvold and Lindkvist, 2015).

Zero Energy Buildings appear detached from city planners view of how Smart Energy Communities should be planned and implemented. Instead, the inclusion of mobility aspects has been raised by all participants. Both projects are interested in including transport as a bridge between Smart Energy Communities and end-user, and as an enabler for the inclusion of utility companies. Transport is seen as the connecting factor; that energy generation interacts with public services/transport planning. City planners however feel that they are mostly influential for energy planning in deciding how housing is located in accordance with local infrastructure; yet national infrastructure plans may change and disrupt the localization process. Therefore, the work of the national infrastructure plans (Vegvesenet) should be more aligned with the overall municipality area planning. That infrastructure has to be in place before a building project starts, may result in an outdated building plan once the project can actually start. This might also stop projects that are in an advanced stage of planning from being realized due to changes in the overall infrastructure plans (external factors).

Business models are also seen as an enabler and a way to bridge the gap between end-user/community scale and smart energy planning. In this context, participants, particularly from private sector, refer to a need for incentives that can influence ‘first movers’ and to reduce financial risk. Private sector participants also mention incentives to stimulate local energy providers through changes in feed-in tariffs and change in national grid policies

Participants from the municipality and region (fylke) express wishes that system boundaries of ZEB-projects somehow move from building-objective to include transport use in the daily life of the inhabitants in zero emission communities. They believe that this would make energy use in buildings more relevant to their work. Identified drivers or incentives influences which stakeholders are interested in being on board, and this further influences where the system boundaries are perceived to be: how can this be used to achieve something? (Example: local energy supply pilots attract stakeholders with waste energy to supply the system with, as well as transportation stakeholders who are driven by the potential of testing new green transport. Municipalities then expand their view of the system to include these.) Another way of perceiving incentives, rather than economic or business model related, is therefore to link them to the system boundaries drafted in Figure 16 and

Figure 11. The way we define and create system boundaries through the inclusion of certain stakeholder groups can function as incentives. Power distributor potentially has the ‘monopoly’ on influencing the design of energy systems and a qualified partner in the municipality may be necessary in order to ‘translate’ what this may mean for the city plan. Alternatively, available or emerging energy planning tools could assist them in analyzing the potential. A supplier of energy will be attracted to participate in a project if interesting customers are present (and vice versa), This means that how we end up defining system boundaries, definitions and KPIs can influence who wants to be on board and how they will contribute. Particularly utility companies in both cases support the idea that system boundary definitions will influence participation and contribution:

“System boundaries will decide everything”

Further work

This report is the first part of PI-SEC Work Package one on municipal planning instruments for smart energy communities. The next step in the work is based on Research Question 2 as outlined in the PI-SEC project description:

Among RQ1 results, have other Norwegian and international projects experienced similar challenges and drivers, and how were they tackled? Which KPIs, targets and planning instruments are transferable to the Norwegian PI-SEC case projects, and which ones seem most relevant to the researchers and case project partners?

Despite the number of tools that match the current needs expressed by the participants, it is difficult to say something specific about their transferability. The transferability needs to be tested and tried out contextually; moreover, the available tools do not necessarily answer the participants wish for flexibility and increased regulatory power at the same time. A possibility will be to create a matchmaking session in relation to the tools with the stakeholders/participants.

Therefore, an analysis should be made that can give indications into which parts of the city planning processes must be more flexible and encourage more collaboration, and in which areas the tools must give more detailed control/regulation.

This study has shown that these recommendations and further tool development in task 2.3 should take the following five hot spots as a starting point:

Five hot spots for tool matchmaking and development

The interfaces between the different system boundaries (Figure 16, Figure 8) that urban planners think can assist this integration include:

1. Energy screening and integrative start-up tools: researchers, regional governor and city planners express a concern that renewable energy resource potentials are not investigated broadly enough at the start phase. Instead, the agreement between builder and property owner or stakeholder presence (konsesjon) influences the end SEC design. Better selection of ground and consequences should be taken into account earlier and this requires a broader integration of renewable energy experts and tools that ensure alignment with regional and city policy from the beginning.

2. Visualization tools of relationships between energy use, energy production, and emissions

3. Triple bottom line (economic, social, environmental) scenario building tools to support decision making for SEC implementation

4. Sustainable user behaviour design of buildings and urban area

5. Stakeholder/incentive based understanding of system boundaries; tools that can help municipalities understand which stakeholders and incentives can benefit the planning and implementation of SECs.

The undertaken study shows the need to create insight on the following issues raised by city planners:

1) There is a need for further examples of tools/approaches/policies for successfully integrating micro energy systems and the larger electric grid in urban settings.
2) Approaches should be identified that have loosened up projects that are 'stuck' due to conflicting agendas through disruption of the "business as usual" process
3) Knowledge-based tools for the future city planning: how can participatory and knowledge-based city planning approaches be scaled and made more time effective to also be integrated into quicker planning processes for ZECs? (problem: urgent need for new housing and city planners see that there is a risk to move directly from plan to building without the inclusion of common visions and participatory processes etc. since these are seen as obstacles to timely implementation)

Towards a preliminary toolkit of municipal planning instruments

Task 2.2 will collect a reference base of Norwegian and international projects that have similar targets, challenges and drivers, evaluate how they were tackled, and whether these experiences are transferable to Norwegian context, specifically to the PI-SEC case projects.

When conducting this task, it is important to remember that the undertaken study shows that participant's understanding of definitions are strongly linked to their own work frame. City planners divide the definition of smart energy communities, smart energy neighbourhoods and Zero Emission Building into scale. For example, one participant said that

> *"Smart Energy Neighbourhood planning should include all energy aspects, down to what people eat for breakfast"*

'Planning Instruments' and 'tools' further seem to follow the understanding that each participant need for the purpose of their own work task performances. These definitions are therefore dependent on their perspective from what they perceive as their own mandate. For instance, city planners and regional governor will refer to the planning and building act as their tools, while utility companies will refer to business model simulators and (energy) researchers will refer to energy resource

calculations. Builders refer to tools that also include carpenters etc. It will be an objective of the further work of this research project to outline a definition of Planning Instruments that take these different concerns into account.

Task 2.2 will further identify and collect examples based on desktop research as well as interaction with Norwegian and international PI-SEC partners. This interaction will consist of workshops applying design thinking tools in order to integrate the needs and contribution of each stakeholder. The reference base of Norwegian & international examples will include not only success stories, but also "glorious failures" related to the specific challenges identified in the PI-SEC projects. The workshops will both include tool matchmaking with researchers as well as further outlining the foundation for new tool development.

Once this task is finished, the planning instruments toolkit will be tested. Task 2.3 will test how the tools chosen in workshops perform when implemented into the PI-SEC cases of neighbourhood development projects, in cooperation with PI-SEC researchers and municipalities. The final step, Task 2.4: will be to give recommendations for policy making and outline transferability of findings.

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